



African Food Tradition rEvisited by Research

FP7 n°245025

Start date of project: **01/09/2010**

Duration: **51 months**

Deliverable number: D 5.4.2.1

Title of deliverable: Report on near-market consumer testing of new improved products in Europe for Group 1

Deliverable type (Report, Prototype, Demonstration, Other): Report

Dissemination level (PU, PP, RE, CO)*: PU

Contractual date of delivery: October 2014

Actual date of delivery: January 2015

Work-package contributing to the deliverable: WP5

Organisation name of lead contractor for this deliverable: ESB/NRI

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This document has been sent to:

The coordinator by WP Leader	Date: January 2015
To the Commission by the Coordinator	Date: January 2015

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Table of Contents

Executive Summary	- 4 -
General approach.....	- 6 -
1. Consumer preference study of Kishk Sa'eedi (KS) reengineered products in Europe.....	- 9 -
1.1 Summary	- 9 -
1.2. Introduction	- 11 -
1.3. Material and methods	- 13 -
1.3.1. Kishk Sa'eedi samples and sample preparation.....	- 13 -
1.3.2. Ethical assessment and consent	- 16 -
1.3.3. Participants.....	- 16 -
1.3.4. Tasting sessions	- 16 -
1.3.5. Consumer acceptance measures.....	- 17 -
1.3.6. Statistical analysis.....	- 18 -
1.3.7. Consumer acceptance measures.....	- 18 -
1.4. Results	- 18 -
1.4.1. Consumer Overall liking and probability consumption scores.....	- 18 -
1.4.2 Evaluation of Intensity of sensory attributes relatively to participants' ideal level, using JAR scales: colour, sweet taste, acid taste and fruity taste.	- 21 -
1.4.3. Marketing questions for KS samples	- 23 -
1.5. Conclusion.....	- 25 -
1.6.Acknowledgement.....	- 26 -
1.7. References	- 26 -
2. Consumer preference study of Akpan reengineered products in Europe	- 27 -
2.1 Summary	- 27 -
2.2 Introduction	- 27 -
2.3 Methodology	- 28 -
2.3.1 Akpan samples.....	- 28 -
2.3.2 Process for making Akpan.....	- 28 -
2.3.3 Ethical assessment and consent	- 29 -
2.3.4 Consumer evaluation methods.....	- 31 -
2.3.6 Statistical analysis.....	- 32 -
2.4 Akpan Results and discussion	- 32 -
2.4.1 Consumer acceptance of Akpan products.....	- 32 -
2.4.2 Segmentation of consumers into groups of similar acceptance patterns regarding the Akpan products	- 33 -
2.4.3 Consumption attitudes	- 35 -
2.4.4 Just About Right	- 35 -
2.4.5 Check-All-That-Apply Question	- 36 -
2.4.6 Willingness to consume Akpan products.....	- 40 -
2.4.7 Suitable packaging for Akpan product	- 41 -
2.5 Akpan Conclusions	- 42 -
2.6 Acknowledgement.....	- 43 -

2.7 Akpan References.....	- 43 -
3. Consumer preference study of Kenkey reengineered products in Europe	- 44 -
3.1 Kenkey Summary	- 44 -
3.2 Kenkey Background	- 44 -
3.3 Kenkey Methodology	- 45 -
3.3.1 Ethical assessment and consent	- 45 -
3.3.2 Consumer evaluation methods	- 45 -
3.3.3 Statistical Analysis.....	- 48 -
3.4 Kenkey Results and discussion	- 48 -
3.5 Kenkey Conclusions.....	- 54 -
3.6 Kenkey References.....	- 54 -
Annex 1 Kishk Sa’eedi consumer questionnaire.....	- 55 -
Annex 2 Akpan consumer questionnaire	- 61 -

Executive Summary

The work described in this deliverable had as main objective the evaluation of European consumer acceptance of products from group 1 that included Akpan and Gowé (Benin), Kenkey (Ghana) and Kishk Sa'eedi (Egypt). In this stage all products were submitted to reengineering process to overcome food safety and product quality issues (identified in the first stage of the project in traditional food) to facilitate their promotion and introduction to EU markets.

Kishk Sa'eedi (KS) is a traditional wheat-based fermented product that has been produced and eaten in homes of Upper Egyptians since the time of the ancient Egyptians, consists of two main ingredients namely: whole parboiled locally grown freshly harvested wheat and unpasteurized fermented buttermilk *Laban Zeer* (buttermilk separated from freshly drawn milk and : the “zeer”). The main objective of this study was to evaluate the acceptance of European consumers of reengineered KS sample compared to the traditional one.

The samples used in consumer test were a traditional KS (KST) and a reengineered KS sample (KSR) that was developed under the AFTER project scope according to an improvement protocol that was conducted in Egypt using a selected starter culture. For consumer acceptability tests, KS samples were served to the consumers after cooked according to a recipe, which consisted in to reconstitute the KS dry balls with water, making a rinse and then pouring the liquid drained (repeating two times). After, this mixture was cooked with butter in a skillet.

In the consumer acceptance tests a panel of a 71 consumers was used. Sample acceptability was assessed by overall liking ratings provided on a 9-point hedonic scale. Hierarchical cluster analysis (Ward's method) was used to segment consumers accordingly. Sensory attributes– flavor, seasoning cumin and texture relatively to participants' ideal level were measured by attribute ratings provided on a 3-point JAR scale. Results showed for both KS samples that the mean overall liking scores obtained were between 2 (dislike very much) and 4 (disliked slightly) and for the probability consumption were between 0 (no consumption) and 2 (slightly possibility consumption), however the reengineering sample (KSR) showed more satisfactory results in terms of overall acceptability, which shows a better acceptance of this product compared to the traditional product. The texture of this product was also penalized as being too soft, especially KST. The results showed that the participants considered ethnic shops, the adequate shops for the marketing of KS and since at least 70% were reluctant to buy this product. The preparation of the KS samples was performed

AFTER (G.A n°245025) – Deliverable 5.4.2.1

Report on near-market consumer testing of new improved products in Europe for Group 1

according to the traditional basic recipe to not alter the sensorial attributes of this food product.

The traditional Portuguese food does not include fermented foods based cereal and milk, which has very characteristics sensory attributes, such as an intense sour flavour, which for Portuguese consumers are unfamiliar flavors. This could help to explain the results obtained in this study.

Akpan is a vegetal yoghurt-like product prepared from a partially fermented cooked maize gruel, named *Ogi* in Benin. This consumer acceptance of Akpan was carried in reengineered product. The main improvements concerned sanitary and sensory properties of the product in view of a broader production in Africa and to conquer European market for diaspora but also for Europeans. After re-engineering, the products “new yoghurt-type” were evaluated for consumer acceptance in Europe using French consumers in Montpellier, France..

Three Akpan products were tested by 102 consumers: Akpan added with 10% sugar (AS10), Akpan added with 3% spray-dried milk and 8.7% sugar (AMS8.7) and Akpan added with 3% spray-dried milk and 15% sugar (AMS15). The three Akpan products were not perceived differently by French consumers. Even if they have an average acceptability, only few people would likely buy it. The re-engineered product was not more acceptable than the traditional one (Fliedel et al., 2013), which was also scored around 5.

If we remove the terms such as “artificial”, “strong in taste”, “floral” due to a manufacturing error (use of a few drops of citronella essential oil instead of citronella infusion as a traditional flavouring of Akpan in Benin), it remains the terms “mealy”, “liquid” “drinking yoghurt” that better describe the product and were previously used for describing traditional Akpan product. This means that sensory properties of traditional Akpan were not totally improved during re-engineering to meet French consumer taste and especially Akpan texture needs to be improved. It must be less liquid, creamier and not mealy. The proportion of uncooked Ogui added to cooked Ogui (to avoid a too thick consistency after starch gelatinization) must be modified, or another alternative must be proposed to reduce consistency of whole cooked Ogui and suppressing mealy sensation, while maintaining its creaminess.

Kenkey is a popular traditional of Ghana with a sour tasting cooked stiff porridge of elastic consistency made from fermented whole meal maize dough shaped into balls or cylindrical forms and wrapped in maize husks or plantain leaves. The aim of this study was to perform consumer testing of Standard Kenkey (Ga Kenkey) compared to Reengineered Kenkey (reengineered Nsiho Kenkey). The reengineered Kenkey was processed following methods

AFTER (G.A n°245025) – Deliverable 5.4.2.1

Report on near-market consumer testing of new improved products in Europe for Group 1 developed by Charlotte Oduro-Yeboah (Amoa et al. 2012). Consumers (n=121) were interviewed at the University of Greenwich, and were asked to score the acceptability with respect to appearance, taste and overall liking using a nine-point verbal hedonic box scale which varied from dislike extremely to like extremely (Meilgaard *et al.* 2007). A CATA (Check All That Applies) and a JAR (Just About Right) tests were also included to help describe the samples' attributes and feelings associated. The results of this research help to provide a basis of understanding on how the reengineered Kenkey (RK) compares to standard commercial Kenkey (SK) in terms of its acceptability by consumers in Europe. Although RK has improved acceptance (5.0 on average) compared to SK (4.3 on average), the acceptance is not high enough for it to be ready to be marketed. In summary 55% of consumers interviewed liked RK (slightly or more) and 45% did not like it. Regarding the standard Ga Kenkey that had a stronger taste, 35% of people liked it (slightly or more) and 65% of people interviewed disliked it a lot. Overall Kenkey product appears to be an unfamiliar product for most consumers and therefore not appealing for most European consumers although it was liked by a fringe of the consumers interviewed.

Gowé is mostly in the centre of Benin, but its consumption is steadily spread to other regions of the country, essentially to the main cities. It is consumed as a beverage after dilution in water and addition of ice, sugar and sometimes milk. Due to limitations in the productions of reengineered product of **Gowé** owing to contaminations of raw material with high aflatoxin content, these results for consumer acceptance could not be obtained, but this was the only case in group I.

General approach

The work encompassed in this deliverable had as main objective the evaluation of European consumer acceptance of products from group 1 (products include the cereal based products) that were submitted to reengineering process to overcome food safety and product quality issues (identified in the first stage of the project in traditional food) to facilitate their promotion and introduction to EU markets.

The products belonging to this group were Akpan and Gowé (Benin), Kenkey (Ghana) and Kishk Sa'eedi (Egypt). Akpan is a vegetal yoghurt-like product prepared from a partially fermented cooked maize gruel, named *Ogi* in Benin. As *ogi* beverage, Akpan has a widespread level of consumption, popularity and high demand. *Ogi* is a fermented cereal

AFTER (G.A n°245025) – Deliverable 5.4.2.1

Report on near-market consumer testing of new improved products in Europe for Group 1

starch extracted from maize/sorghum/millet and used in a variety of ways to make porridge. It is usually mixed with condensed milk, ice and sugar by street vendors just before consumption. It is thirst quenching beverage in Benin, very much appreciated by consumers in urban areas.

Gowé is one of the many popular traditional fermented products locally available and commonly consumed in Bénin. Gowé is a homogenous gelatinised, malted, fermented and cooked paste prepared from sorghum, millet or maize. It is produced by small scale processors and consumed as a thirst quencher, social drink and energy drink. Originally, Gowé is mostly in the centre of Benin, but its consumption is steadily spread to other regions of the country, essentially to the main cities. It is consumed as a beverage after dilution in water and addition of ice, sugar and sometimes milk. It is the preferred beverage of children, pregnant women, sick and old people in Benin.

Kenkey is the principal and most popular fermented food made from maize in Ghana and has been described as one of the best examples of traditional African foods that has played a significant role through history in food security as well as food safety. There are different types of Kenkey based mainly on the procedure used in preparation and the material used in packaging. Kenkey is a popular traditional and is a staple for most of the peoples in the coastal regions of Ghana. It is a sour tasting cooked stiff porridge of elastic consistency made from fermented whole meal maize dough shaped into balls or cylindrical forms and wrapped in maize husks or plantain leaves.

Kishk Sa'eedi (KS) is a homemade fermented wheat-based stable food that has been produced and eaten in Upper Egypt since the time of the ancient Egyptians. The name "kishk " refers to a group of popular fermented dairy cereal mix products common to Egypt and the Middle East. The term Sa'eedi is the designation that is given to the people of the Sa'eed or the South of Egypt. KS is the undisputed national food of Upper Egyptians where it shares the importance of bread as a basic component of the diet.

The know-how for preparation of *KS* is handed down from mother to daughter across generations. The production of *KS* is commonly home based and is typically prepared by mixing *Laban Zeer* (buttermilk separated from freshly drawn milk and left to sour in an unglazed earthenware container: the “*zeer*”) with coarsely ground parboiled wheat. The milk is fermented alone, then mixed and fermented again with the coarsely ground mature whole wheat that had been previously parboiled and sun dried.

The products selected for European studies of reengineered products at this stage were Akpan, Gowé, Kenkey and Kishk Sa'eedi.

AFTER (G.A n°245025) – Deliverable 5.4.2.1

Report on near-market consumer testing of new improved products in Europe for Group 1

In this deliverable are reported results concerning consumer preference studies that instead of a trained panel used a large number (60 or more) of consumers, who scored the product only for liking or acceptance. This method assesses personal responses (acceptance or preference) of consumers regarding to a product, idea or specific product characteristics. In this deliverable are reported the reengineered product.

In order to efficiently assess the European consumer preference and perception of the products from group 1 (four fermented cereal-based products) the study was structured according the product, as follows:

Kishk Sa’eedi study: Consumer preference study was performed in Portugal using Portuguese consumers for reengineered Kishk Sa’eedi product compared to the traditional one.

Akpan study: Consumer preference study was performed in France using French consumers for reengineered akpan “new yoghurt-type product”.

Kenkey study: Consumer preference study was performed in UK for reengineered sample including Reengineered Kenkey (reengineered Nsiho Kenkey) compared to Standard Kenkey (Ga Kenkey)

1. Consumer preference study of Kishk Sa'eedi (KS) reengineered products in Europe

1.1 Summary

Kishk Sa'eedi (KS) is a traditional wheat-based fermented product that has been produced and eaten in homes of Upper Egyptians since the time of the ancient Egyptians, consists of two main ingredients namely: whole parboiled locally grown freshly harvested wheat and unpasteurized fermented buttermilk *Laban Zeer* (buttermilk separated from freshly drawn milk and : the “zeer”).

The main objective of this research was to evaluate the acceptance of European consumers of reengineered KS sample compared to the traditional one.

The samples used in consumer test were a traditional KS (KST) and a reengineered KS sample (KSR). The KSR was developed under the AFTER project scope according to an improvement protocol that was conducted in Egypt.

For consumer acceptability tests, KS samples were served to the consumers after cooked according to a recipe, which consisted in to reconstitute the KS dry balls with water, making a rinse and then pouring the liquid drained (repeating two times). After, this mixture was cooked with butter in a skillet.

In the consumer acceptance tests a panel of a 71 consumers was used. Sample acceptability was assessed by overall liking ratings provided on a 9-point hedonic scale. Hierarchical cluster analysis (Ward's method) was used to segment consumers accordingly. Sensory attributes– *flavor, seasoning cumin and texture* relatively to participants' ideal level were measured by attribute ratings provided on a 3-point JAR scale.

The results for KST and KSR showed that the mean overall liking scores obtained were between 2 (dislike very much) and 4 (disliked slightly) and for the probability consumption were between 0 (no consumption) and 2 (slightly possibility consumption).The KSR showed better acceptance that KST.

The consumers considered that the best shops for marketing KS were the ethnic shops, and they preferred to buy another identical type of foods that to buy this product.

It is important to highlight that this products is usually prepared using more complex recipes with chicken and other diverse seasonings that mask the strong acid fermented buttermilk and cumin flavours, however in order to test the perception of basic attributes of the product, and

AFTER (G.A n°245025) – Deliverable 5.4.2.1

Report on near-market consumer testing of new improved products in Europe for Group 1
due to the limited quantity of sample to test, we decided to use the simplest recipe, which
probably contribute for the negative acceptance of these products.

1.2. Introduction

Fermented milk–wheat mixtures, known as kishk in the Middle East and tarhana in Greece and Turkey, are important foods in the diet of many populations. The name "Kishk" refers to a group of popular fermented dairy-cereal mix products and their variations. According to Tamime (1995) there are three main kinds of food referred to as “Kishk”, and the designation of this product may vary depending on country or region, thus, it is extremely difficult to find a common definition for Kishk which adequately covers all these products.

In the present AFTER Project, the traditional name *Kishk Sa'eedi* (KS) is reserved for the Egyptian product prepared traditionally according to the method applied by Upper Egyptians, however, the methods employed for the production of Egyptian *Kishk Sa'eedi* (KS) may differ from one region to another because these processes are based on traditional local knowledge systems. One of the variations in KS is the milk-free *kishk* that is eaten during the fasting months for the Copts, the Egyptian Christians (El-Gendy, 1983).

Kishk Sa'eedi is an indigenous food that is part of the rich food heritage of Egypt and the cereal based fermented food *Kishk Sa'eedi* (KS) constitutes a major source of high quality dietary nutrients for millions of Egyptian. It is a basic traditional food for Upper Egyptians and is popular among all social strata.

The production of KS is commonly home based and the know-how is transmitted from mother to daughter. It is produced on a small scale in homes and in villages.

The KS consists of two main ingredients namely: whole parboiled locally grown freshly harvested wheat and unpasteurized fermented buttermilk *Laban Zeer* (buttermilk separated from freshly drawn milk and left to sour in an unglazed earthenware container: the “zeer”). The locally grown mature freshly harvested whole wheat is boiled in a metal barrel on an open fire until soft then sun dried, milled (coarse) and sieved in the *ghorbal* in order to remove the finely ground part of the wheat meal. The concentrated *Laban Zeer* that is fermented for at least 40 days is mixed with the moistened coarsely ground parboiled wheat in a large earthenware *magour*, to produce a heavy paste called “*hama*”. The milk cereal mixture is then allowed to ferment again for about 24 hours after which it is kneaded with the addition of more of the fermented salted milk diluted with a little water to reach the required consistency. Alternatively, the fermentation of the *hama* allowed to continue for a further 24 hours. The resultant mass is thoroughly mixed incorporating the aromatic spices, namely whole cumin seeds are added just before cutting and shaping the fermented *hama*. In some

AFTER (G.A n°245025) – Deliverable 5.4.2.1

Report on near-market consumer testing of new improved products in Europe for Group 1

households, a small quantity of finely ground hot chili pepper is added as well. After, *hama* is cutting into unformed chunks (of about 3 cm in diameter) or shaped into small balls of about 2 cm in diameter, which are arranged on a reed mat to dry in the sun. The product is stored in the form of the dried product.

KS forms part of the regular food intake of the average individual in the south of Egypt and it can be at all meals under different forms of preparation and it serves as the food of choice for the sick. KS is usually reconstituted with water and is consumed as a hot gruel, often with the incorporation of vegetables, spices, garlic, or herbs. It can form the core ingredient in savory and sweet dishes (Morcos et al 1973). Together with bread - KS is a basic component of the dietary system for Upper Egyptians and can be consumed at all meals, morning, mid-day or evening.

One of the unique features of KS is that it can be eaten at all stage of preparation (Ahmed ZS and Hassan-Wassef H, unpublished data). Diluted *Laban Zeer* is consumed in summer on its own as a refreshing drink. The *hama* (mixture of *Laban Zeer* and parboiled ground wheat) is consumed as a sour paste for breakfast or as a semisolid mash as an accompaniment to vegetables and eggs.

The final dried balls/chunks can be eaten as a snack and are a common school snack for Upper Egyptian children. Reconstituted in water, KS serves as the basis for preparation of many savoury and sweet dishes. It can be cooked with meat or poultry as a kishk stew. Two KS balls soaked in a glass of water is the first drink on waking up in the morning for many Upper Egyptian women.

For households with limited incomes, a few KS balls thrown in the cooking pot replace meat in the preparation of the daily vegetable stew.

KS possesses a characteristic pleasant aroma and flavor and bears the slightly acidic taste of the fermented buttermilk and is a highly nutritious food, having a protein content of about 23,5% (Morcos, 1993). The fermentation involves in the process of production of KS that of a wheat and buttermilk mixture produces a food product of high digestibility and high biological value, the food fermentations that raise the protein content that are particularly valuable for children and the micronutrient density of a final product that is characterized by being low in saturated fats and high in fiber that is a source of balanced essential amino acids derived from combining the milk and wheat proteins. The bioactive peptides that are the products of degradation of milk proteins through fermentation are known to be responsible for a wide range of biological functions in the body that can eventually positively impact on health. The same combination makes of KS a richer source for the B vitamins than for milk or

AFTER (G.A n°245025) – Deliverable 5.4.2.1

Report on near-market consumer testing of new improved products in Europe for Group 1

wheat on their own. In addition, the fermentation process enhances the bioavailability of the calcium, iron, magnesium and zinc content.

The fermenting agents, now selected and isolated, could produce several antimicrobials that contribute to the characteristic aroma of KS and prevent spoilage because of a their antibacterial action. The potential for probiotic health promoting effect of the cultures used in KS production (though not yet proven to KS) are known to inhibit bacterial pathogens in the bowel and reduce the colon cancer risk, stimulate immune response and reduce serum cholesterol levels.

The high nutritional as well as functional quality of the traditional KS, calls for an innovative research to produced second generation KS products that are adapted to the preferences of the modern consumer and to the demands of modernity. The survey was conducted by an international collaborative project funded by the European Union "African Food Tradition Revisited by Research" (AFTER).

In studies carried out under the project were applied technologies for optimization of a novel cereal-based snack inspired from traditional KS and to investigate the proximate chemical composition (i.e. moisture, protein, ash, acidity and minerals), the microbial quality and microstructure proprieties for the purpose of improving these products.

The new KS snack was made from a dough containing salt, cumin, mixture of buttermilk and full fat milk (inoculated by a mixture of *Lactobacillus rhamnosus*, *Lactobacillus gasseri* and *Lactobacillus lactis subsp lactis*) and either parboiled whole wheat or soaked then parboiled whole wheat. After fermentation, the dough was shaped, dried and grounded to a powder.

The main objective of this research effort was study the acceptability by Portuguese consumers of two KS samples (n=2), one obtained from traditional process and the other developed in this project through a reengineering process using a controlled starter culture.

Consumer hedonic acceptance, Just-About-Right intensity evaluation of specific descriptors and (JAR) were used to establish consumer's acceptance.

1.3. Material and methods

1.3.1. Kishk Sa'eedi samples and sample preparation

Two Kishk Sa'eedi (KS) samples were used in consumer test: a traditional KS and a reengineered KS sample. The reengineered KS sample was developed under the AFTER project scope according to an improvement protocol that was conducted in Egypt.

AFTER (G.A n°245025) – Deliverable 5.4.2.1

Report on near-market consumer testing of new improved products in Europe for Group 1

The reengineered KS sample was made from a dough containing salt, cumin, mixture of butter milk and full fat milk (inoculated with selected strains) and either parboiled whole wheat or soaked then parboiled whole wheat. After fermentation, the dough was manually shaped into small ball.

For the purpose of the consumer acceptability testing in Portugal, it is proposed that KS samples were served to the consumers after cooked according to the following recipe:

cover the KS balls with cold water and let soften for about 10 minutes with the purpose of the samples absorb the water (Figure 1-A). When the KS samples were completely reconstituted, drain well and add once again cold water and drain new completely discard the excess water squeezing out by hand the extra water then separated the grains with a fork (Figure 1-B, C and D). Turn the mixture in a little hot butter on a slow fire till the excess water is absorbed/evaporates leaving the *bulgur-like* grains of KS that can be used for tasting (Figure 1-E and H).

AFTER (G.A n°245025) – Deliverable 5.4.2.1

Report on near-market consumer testing of new improved products in Europe for Group 1

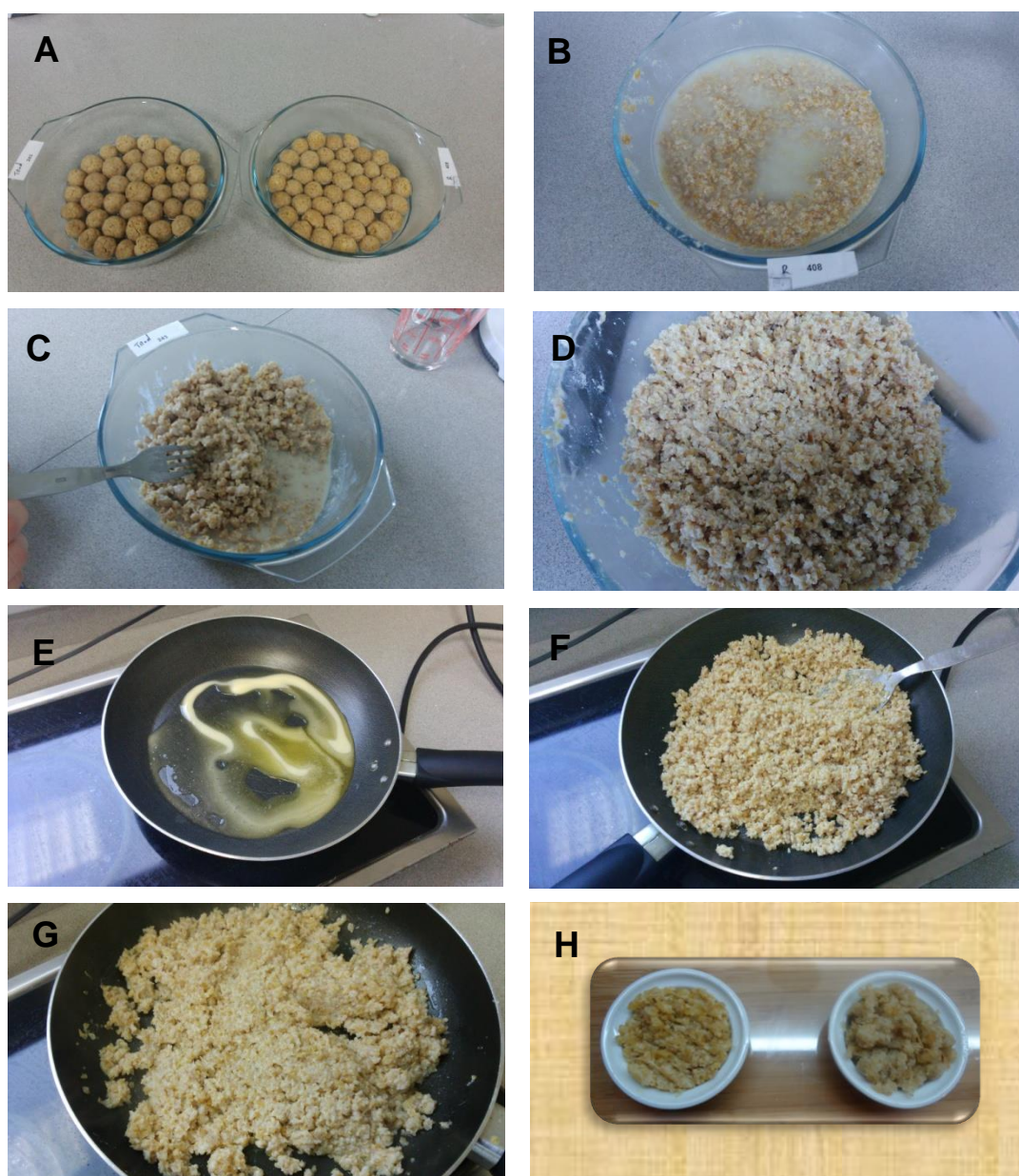


Figure 1 - Preparation of the Kishk Sa'eedi (KS) samples to be served to consumers. **A** - KS balls covered with cold water; **B** - Drain and new addition of cold water; **C** and **D**- New drain and separation of particles grains squeezing out the extra water ; **E**, **F** and **F** - Preparation of KS in the skillet using a little butter. **H** – KS samples already prepared and ready to serve.

Two different samples were presented to consumers as the following (Figure 2):

1. KS traditional sample (KST)
2. KS reengineering sample (KSR)

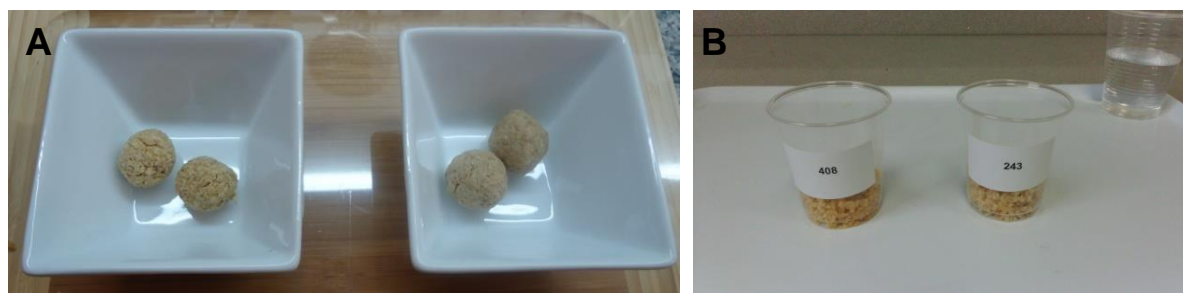


Figure 2 – A - Kishk Sa'eedi (KS) dry balls, KST and KSR only to show as reference or original product; B - Kishk Sa'eedi (KS) samples, KST and KSR for consumers taste.

1.3.2. Ethical assessment and consent

The study was reviewed by project AFTER's Ethics Committee. Participants were informed about the study's general aim and procedures for handling personal data, and gave written informed consent prior to participating in the tasting sessions. Interviewers informed participants about the study and explained that their participation was entirely voluntary, that they could stop the interview at any point/time and that the responses would be anonymous. All tested samples were produced and prepared according to good hygiene and manufacturing practices. No safety or health concerns were detected in the samples.

1.3.3. Participants

Participants were non-probabilistically recruited in Portugal (Porto, n=71), according to their willingness and availability to participate in the study. The participants were balanced in terms of gender and age.

1.3.4. Tasting sessions

Tasting session was conducted in the building of Escola superior de Biotecnologia (ESB) – UCP in a room equipped with computers, since the questionnaire were conducted in portable computers. The questionnaire was written in Portuguese and was introduced in Qualtrics online survey software in order to simplify the collection of the information. Qualtrics is a software platform used by ESB – UCP. Qualtrics software was used (Qualtrics, LLC).

Corresponding to a dessert spoon of each KS sample was served in clear plastic glasses, following a complete balanced experimental plan. The two KS samples for consumer tasting

AFTER (G.A n°245025) – Deliverable 5.4.2.1

Report on near-market consumer testing of new improved products in Europe for Group 1 were a traditional KS and a reengineered KS sample. Each sample was identified by a random code with 3 digits. Water was supplied to clean the palate between tastings. Participants were informed for safety considerations. The samples were presented to consumers after cooking preparation (see Figure 3).



Figure 3 - Kishk Sa'eedi tasting sessions in ESB-UCP.

The questionnaires can see in Annex 1

1.3.5. Consumer acceptance measures

Consumer acceptance was measured by overall liking ratings, provided on a 9-point hedonic scale (1 = “dislike extremely, 9 = “like extremely”) (Jones, Peryam, & Thurstone, 1955; Peryam & Girardot, 1952; Peryam & Pilgrim, 1957). The intensity of three sensory attributes – *flavor, seasoning cumin and texture* -, relatively to participants' ideal level, was measured by ratings provided on a 3-point, just-about-right scale [*too weak* (TW), *just-about-right* (JAR), *too strong* (TS)].

1.3.6. Statistical analysis

XLSTAT software (Addinsoft SARL, France) was used to carry out all statistical analyses. The significance of statistical tests was evaluated at $p < 0.05$, unless otherwise mentioned.

1.3.7. Consumer acceptance measures

Analysis of Variance (ANOVA) was performed on overall liking ratings for the two samples, considering participants and samples as sources of variation. Mean sample ratings were calculated and significant differences between them tested post-hoc using Fisher's LSD (Least Significant Difference) tests. Pair-wise Pearson correlations between samples' overall liking ratings were then computed to assess their degree of association.

The frequency of intensity ratings (TW, JAR, TS) for each of the three sensory attributes evaluated by participants was determined for each sample, and the corresponding proportions calculated. A penalty analysis (Popper, 2014) was employed to relate attribute intensity ratings to overall liking ratings for each participant and sample. To this end, participants were grouped according to their intensity ratings for each sample and attribute, and mean overall liking ratings for each group were computed. The overall liking mean drops, or penalties, obtained when comparing the TW and the TS group with JAR participants were then calculated. Weighted penalties (Popper, 2014) were equally computed by taking both the mean drops and the proportion of participants in each group.

1.4. Results

1.4.1. Consumer Overall liking and probability consumption scores

The overall acceptability for the two KS samples showed that there were significant differences between the KS traditional sample (KST) and KS reengineering sample (KSR) at a significant level of $p \leq 0,01$ (One-way ANOVA), and as can be seen in Table 1 the mean overall liking scores obtained for the KST sample was 2,225 and 3,423 for KSR.

Regarding the samples used during consumer study it was possible to verify that samples were on the range since the mean scores were between 2 (dislike very much) and 4 (disliked slightly).

AFTER (G.A n°245025) – Deliverable 5.4.2.1

Report on near-market consumer testing of new improved products in Europe for Group 1

Table 1 - Mean overall liking scores (descriptive statistics analysis) for KS samples tested.

Statistic	Overall liking	
	KS traditional sample	KS reengineering sample
No. of observations	71,000	71,000
Minimum	1,000	1,000
Maximum	7,000	8,000
Median	2,000	3,000
Mean	2,225	3,423
Standard deviation (n-1)	1,396	2,352
Lower bound on mean (95%)	1,895	2,866
Upper bound on mean (95%)	2,556	3,979
Mean absolute deviation	1,072	2,089
Ic 95%	0,330	0,557

Although the overall liking scores obtained for both samples were low, KSR was the most preferred sample, in a decrease order of magnitude.

Similar results were obtained for the overall acceptability for the two KS samples, and showed significant differences between KST and KSR at a significant level of $p \leq 0,01$ (One-way ANOVA). The mean overall probability consumption scores obtained for the KST sample was 0,732 and 2,207 for KST (Table 2), and the both samples were on the range since the mean scores were between 0 (no consumption) and 2 (slightly possibility consumption).

Table 2 - Mean overall probability consumption scores (descriptive statistics analysis) for KS samples tested.

Statistic	Overall probability consumption	
	KS traditional sample	KS reengineering sample
No. of observations	71,000	71,000
Minimum	0,000	0,000
Maximum	10,000	10,000
Median	0,000	1,000
Mean	0,732	2,070
Standard deviation (n-1)	1,681	2,779
Lower bound on mean (95%)	0,334	1,413
Upper bound on mean (95%)	1,130	2,728
Mean absolute deviation	1,011	2,321
Ic 95%	0,398	0,658

AFTER (G.A n°245025) – Deliverable 5.4.2.1

Report on near-market consumer testing of new improved products in Europe for Group 1

As depicted in Figure 4 for KST it can be observed that 93% of consumers “dislike “ this sample, while KSR obtained 66,2% in the range between 1 and 4. Moreover, in the range between 6 and 9, which represents the range of consumers who “liked” the samples, KSR obtained 31% while KST only obtained 4,2% .

Concerning the probability of consumption (Figure 5) it can be observed that 95,8% of consumers for KST and 77,5% for KSR would not consume these samples if it was available in the market. Only 2,8% of consumers for KST and 15,5% for KSR probably would consume these samples.

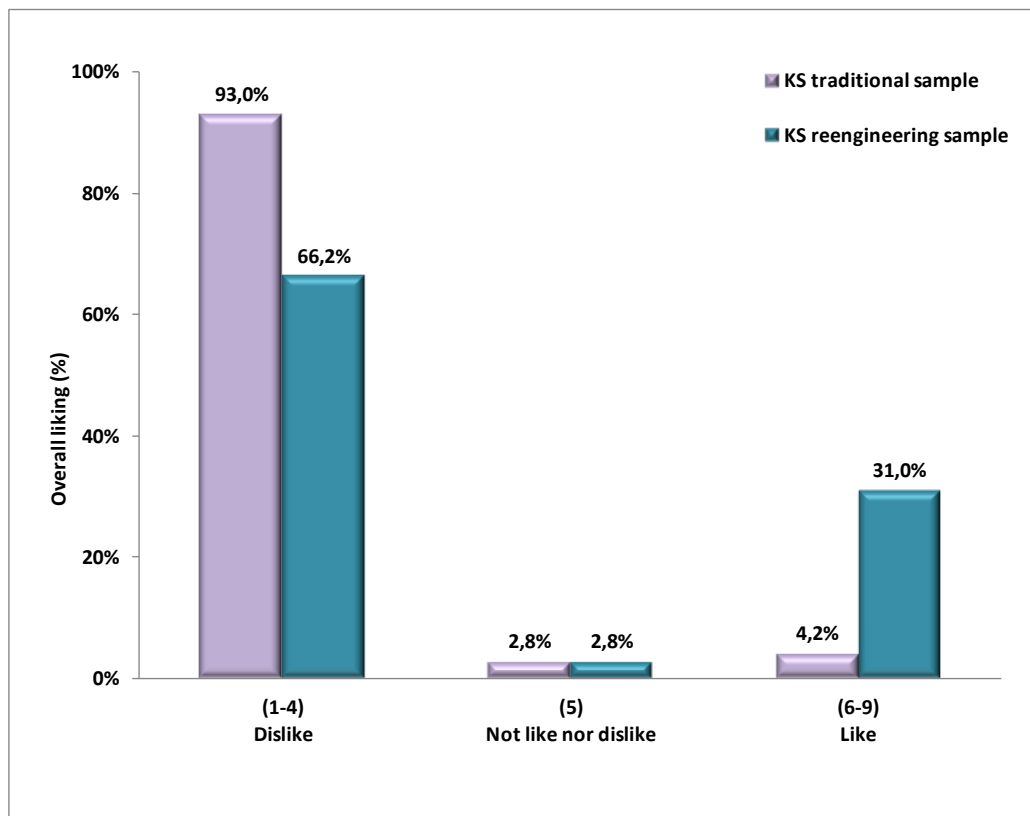


Figure 4 – Mean consumer overall liking (%) for KS samples: KS traditional sample (KST) and KS reengineering sample (KSR).

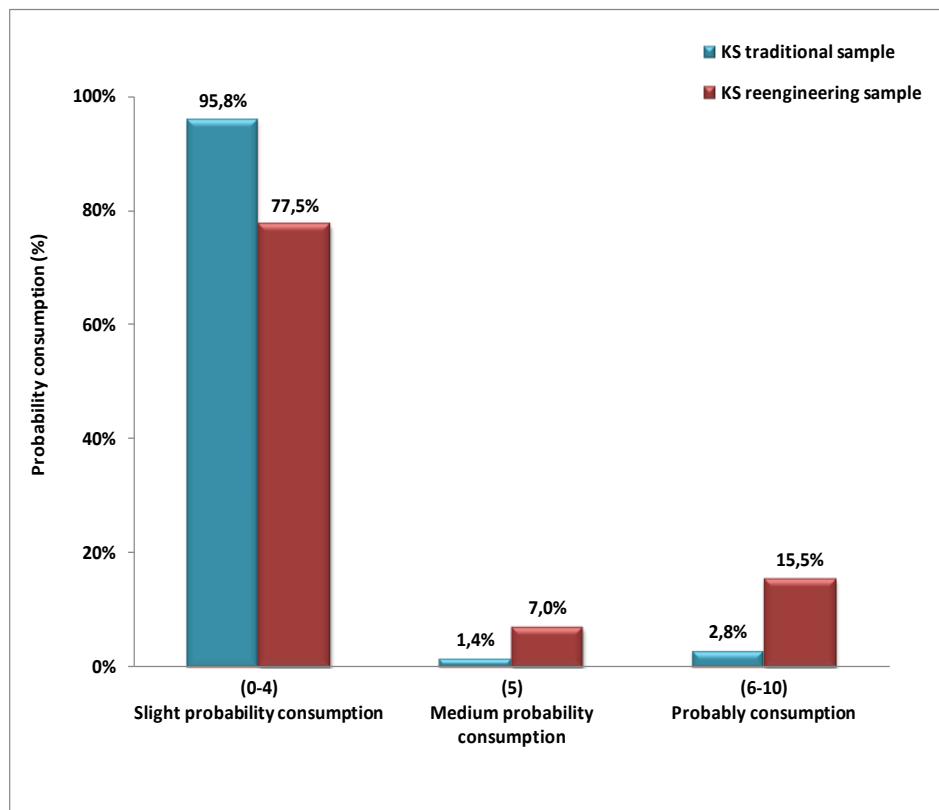


Figure 5 – Mean overall probability consumption (%) for KS samples: KS traditional sample (KST) and KS reengineering sample (KSR)

1.4.2 Evaluation of Intensity of sensory attributes relatively to participants' ideal level, using JAR scales: colour, sweet taste, acid taste and fruity taste.

Figure 6 shows the frequencies of intensity ratings, measured on a 3-point JAR scale, for each KS samples and sensory attribute evaluated (*flavor, seasoning cumin and texture*).

Comparing two samples, it can be observed a preponderance of JAR (Just-About-Right) ratings for KSR for the three attributes evaluated, with their frequencies ranging from 23% to 34%. This is well in line with overall liking results, which showed that KSR was the preferred sample.

For both samples, the flavor was the attribute which showed higher ratings for TS (Too strong) with ratings above 52% and KSR was considered the sample with stronger flavor, with 70%. Respect to the texture and seasoning cumin, the TW (Too weak) ratings dominated for these two attributes for KST, with 62% and 48%, respectively, showing that this sample is softer and more homogeneous than KSR.

AFTER (G.A n°245025) – Deliverable 5.4.2.1

Report on near-market consumer testing of new improved products in Europe for Group 1

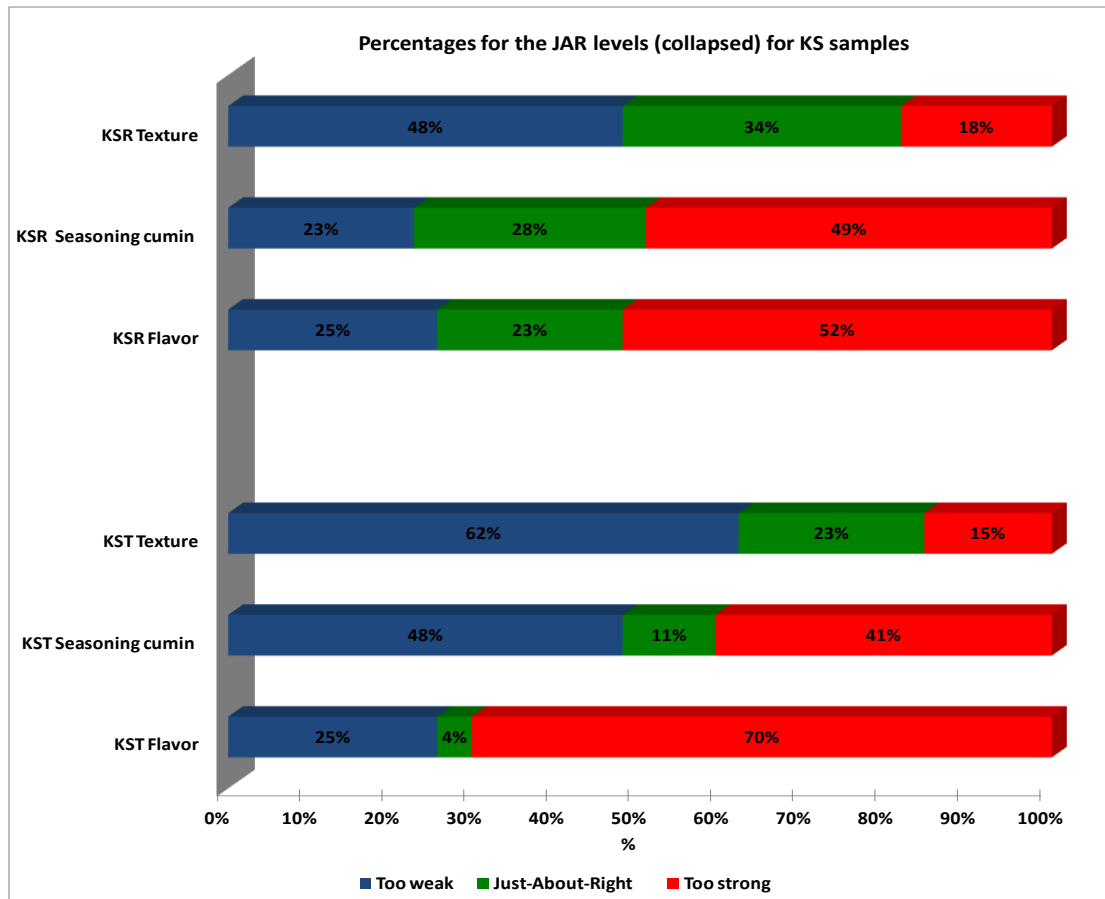


Figure 6 – JAR evaluations (%) for KS samples: KS traditional sample (KST) and KS reengineering sample (KSR).

With the purpose of identifying attributes which appear to have a strong impact on overall liking, weighted penalties were calculated for all samples and attributes. The weighted penalties are represented in figure 7. Mean drops of 1.0 for nine-point overall liking scale and 20% respondents, are often considered the cut-off for a meaningful decline in acceptance related to a particular attribute, for this reason weighted penalties below 20 are usually considered negligible. All KS samples showed strong flavor, however the sample that stood out was KST. The KST showed weaker seasoning cumin than KSR, as expected since this reengineering sample was added with cumin as a powder. For texture both samples were penalized as a weak texture thus they were considered to be too soft, although the KST sample showed a higher percentage than KSR.

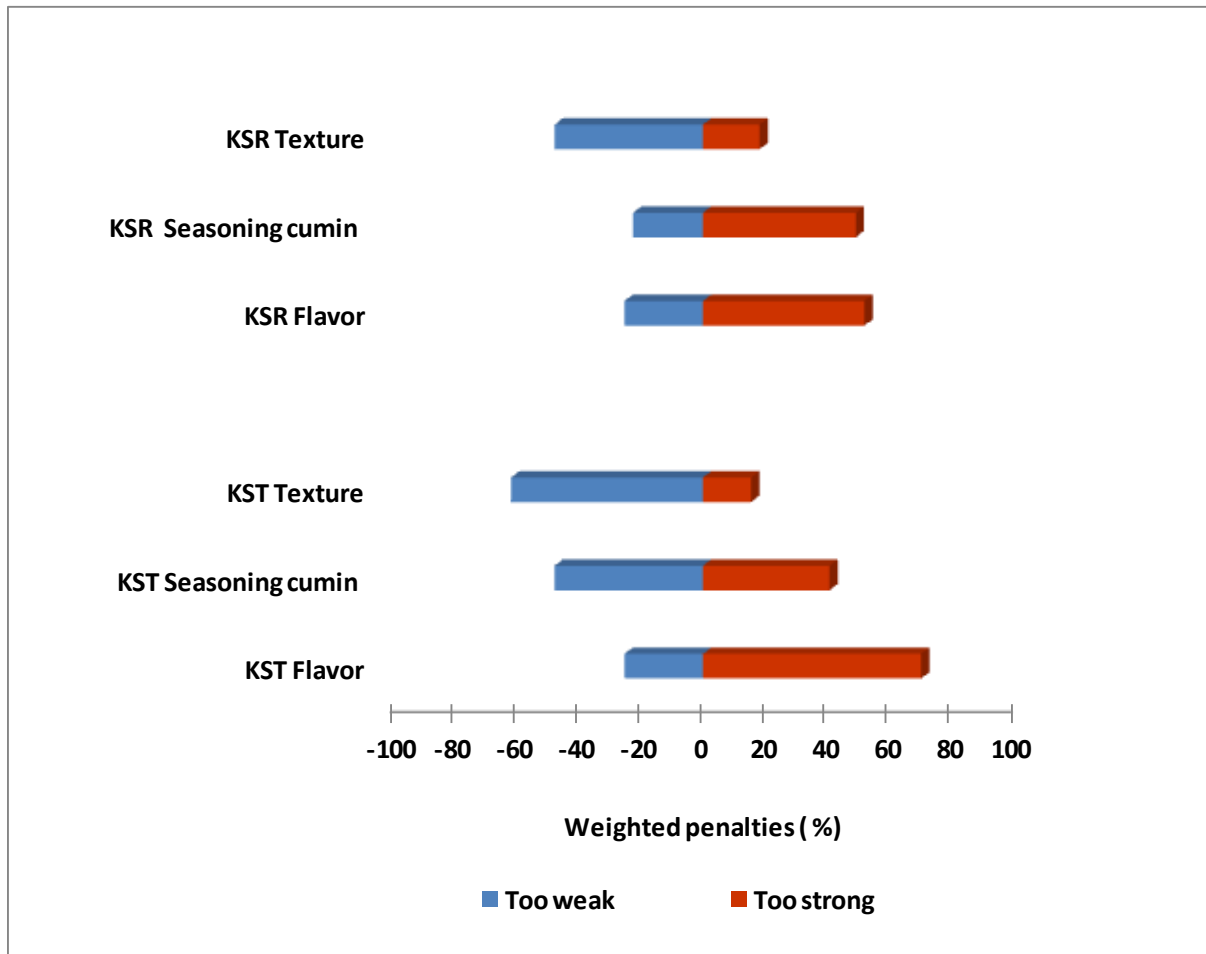


Figure 7 - Representation of the weighted penalty (%) values relating overall liking ratings drops for each KS samples and attribute in relation with JAR attribute intensity ratings for all participants (n=71) for KS traditional sample (KST) and KS reengineering sample (KSR).

1.4.3. Marketing questions for KS samples

Marketing questions concerning the purchase attitudes were presented to participants in the consumer tests conducted in Portugal.

Regarding consumption habits were asked to participants to indicate the shops that considered appropriate to purchase KS. The figure 8 shows that 45% of participants considered the ethnic shops the most appropriate shop for the sale of these type of products. The second choice was gourmet shops/delicatessen with 23%, just followed by supermarket gourmet sections with 21%.

AFTER (G.A n°245025) – Deliverable 5.4.2.1

Report on near-market consumer testing of new improved products in Europe for Group 1

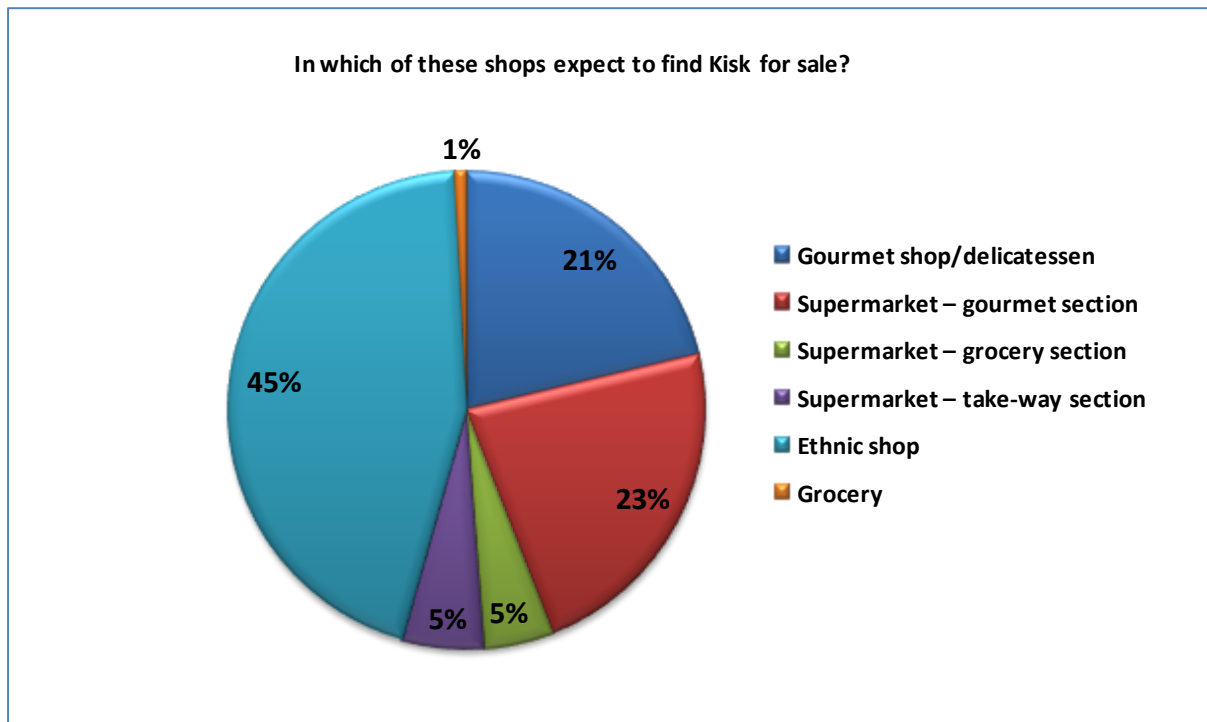


Figure 8 - Shops those participants considered more appropriate for the sale of KS.

It was intended to assess if participants would be willing to pay more or less for a KS meal than other type of meal such as Mexican, Indian etc. The results showed that for KST, 83% of participants were willing to pay much less than ethnic meal and for KSR this value was 70%. The results for the participants' willingness to pay the same were 17% for KST and 27% for KSR. For KST no one would be willing to pay more for this sample by other ethnic identical products while for KSR only 3% of participants would be willing to pay more.

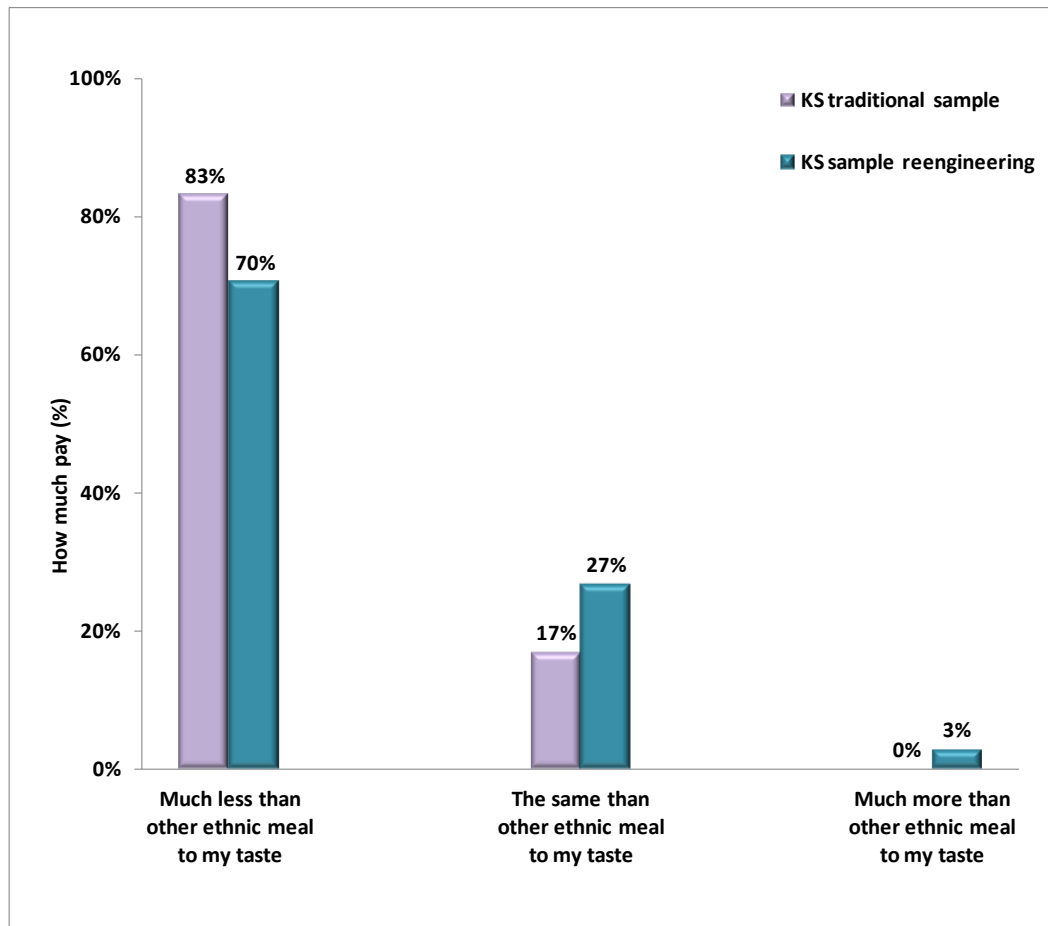


Figure 9 – Participants results to the answered how much would be willing to pay for KS traditional sample (KST) and KS reengineering sample (KSR).

1.5. Conclusion

For both KS samples used in this consumer test, it was possible verify that the mean overall liking scores obtained were between 2 (dislike very much) and 4 (disliked slightly) and for the probability consumption were between 0 (no consumption) and 2 (slightly possibility consumption), which can be considered a negative result, however the reengineering sample (KSR) showed more satisfactory results in terms of overall acceptability, which shows a better acceptance of this product compared to the traditional product.

The preparation of the KS samples was performed according to the traditional basic recipe to not alter the sensorial attributes of this food product.

The traditional Portuguese food does not include fermented foods based cereal and milk, which has very characteristics sensory attributes as an intense sour flavor; which for

AFTER (G.A n°245025) – Deliverable 5.4.2.1

Report on near-market consumer testing of new improved products in Europe for Group 1

Portuguese consumers are unfamiliar flavors. This could help to explain the results obtained in this study. Furthermore, cumin is a spice used in a very small number of traditional dishes and it is not widely consumed in Portugal, which may explain that many of the participants can not appreciate the flavor of this spice. The texture of this product was also penalized as being too soft, especially KST.

The results showed that the participants considered ethnic shops, the adequate shops for the marketing of KS and since at least 70% were reluctant to buy this product.

Moreover, the employment of overall liking assessments and JAR technique and uncovered important drivers for further sensory optimization of the KS samples improved through reengineering processes.

Probably, for the European consumers these reengineering KS should also be adjusted, one way to improving these results, could pass for using new recipes and probably would be added another spice or a blend of spices to adapt to the taste of Portuguese consumers.

1.6.Acknowledgement

This publication is an output from a research project funded by the European Union (FP7 245–025) called African Food Revisited by Research (AFTER - <http://www.after-fp7.eu/>), with additional financial support and FCT (Fundação para a Ciência e a Tecnologia) – PEst OE/EQB/LA0016/2013. The views expressed are not necessarily those of the European Union.

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2. Consumer preference study of Akpan reengineered products in Europe

2.1 Summary

French consumer acceptability of re-engineered Akpan product, was carried out in Montpellier, France. Three Akpan products were tested by 102 consumers: Akpan added with 10% sugar (AS10), Akpan added with 3% spray-dried milk and 8.7% sugar (AMS8.7) and Akpan added with 3% spray-dried milk and 15% sugar (AMS15). No significant difference was observed among the three products regarding their overall acceptability, all of them having an average score around 5 (neither like nor dislike). Three groups of consumers were identified: the Akpan indifferent likers (48%), the too sweet Akpan dislikers (38%) and Akpan dislikers (14%). Whatever Akpan product tasted, Acidity or Sweetness were scored “Just About Right, as I like” by 56 to 77% of consumers. Odour was perceived differently, depending on consumers. However, Texture was found “Too weak”, too liquid by the majority of consumers (49 to 55%) and Taste “too strong” (46 to 54%). The most frequently CATA descriptors checked by consumers which better described Akpan products were: “Artificial”, “Floral”, “New/Different”, “Strong in Taste”, “Mealy”, followed by “Liquid”, “Drinking yoghurt”, “Sweet”, “Acidic”, and “Rough”. At the opposite, an “ideal” yoghurt was described as Creamy, Natural, Good for health, Refreshing, Homogeneous, with a texture of a Bulgarian yoghurt-type, Thick, Sweet, Attractive, Nutritious and Milk taste. Whatever Akpan product, 56 to 66% of consumers would not buy and consume it (no chance for 23-24% consumers, very low possibilities for 11 to 20%, and low possibilities for 22 to 26% consumers).

2.2 Introduction

A first study on consumer acceptance of Akpan was carried out previously in France to collect French consumer views on that Beninese yoghurt-like product in view of re-engineering its process.

The main improvements concerned sanitary and sensory properties of the product in view of a broader production in Africa and to conquer European market for diaspora but also for Europeans. After re-engineering, French consumers were asked, in this current study, to give their impressions on that “new yoghurt-type product”.

2.3 Methodology

2.3.1 Akpan samples

Akpan was prepared in Cirad laboratory from white maize grains provided by UAC, Cotonou, Benin.

2.3.2 Process for making Akpan

The traditional process for making Akpan from white maize grains was described previously by Fliedel et al. (2013). It involves several successive steps such as steeping maize grain, grinding, sieving to separate bran, fermenting and precooking.

In view of reducing the risk of contamination of the product, some of these steps were revisited (Adinsi et al., 2014).

- Soaking the grains was carried out at relatively high temperature (50°C, 15h) to inhibit undesirable microorganisms and prevent the cooking of the grains.
- A pasteurisation step (70°C, 15min) of the sieved material was introduced before fermentation to reduce the load of pathogenic microorganisms, and promote the efficiency of a starter culture (*Lactobacillus casei*) during controlled fermentation (42°C, 15h).
- Milk and sugar were added into the sieved material before fermentation, to avoid risk of contamination after cooking.
- A part of Ogui (50%) was added to a boiled citronella infusion and cooked (90°C, 10min). The other part was pasteurized (70°C, 15min).
- After cooling to a temperature below than 70°C, precooked Akpan was mixed with pasteurized Ogui and the mixture was well homogenized to give Akpan ready to taste.

This improved process was applied in Benin to produce re-engineered Akpan products (Adinsi et al., 2014) that were used for consumer tests with Beninese consumers. The proportion of sugar was 15% and the product AMS15. In France, Akpan products were produced according to the same process but several proportions of sugar and milk were tested (15% sugar as in Benin, and lower proportion of sugar, since the previous study showed that French consumers do not like too sweet products) .

AFTER (G.A n°245025) – Deliverable 5.4.2.1

Report on near-market consumer testing of new improved products in Europe for Group 1

The following three Akpan products were prepared:

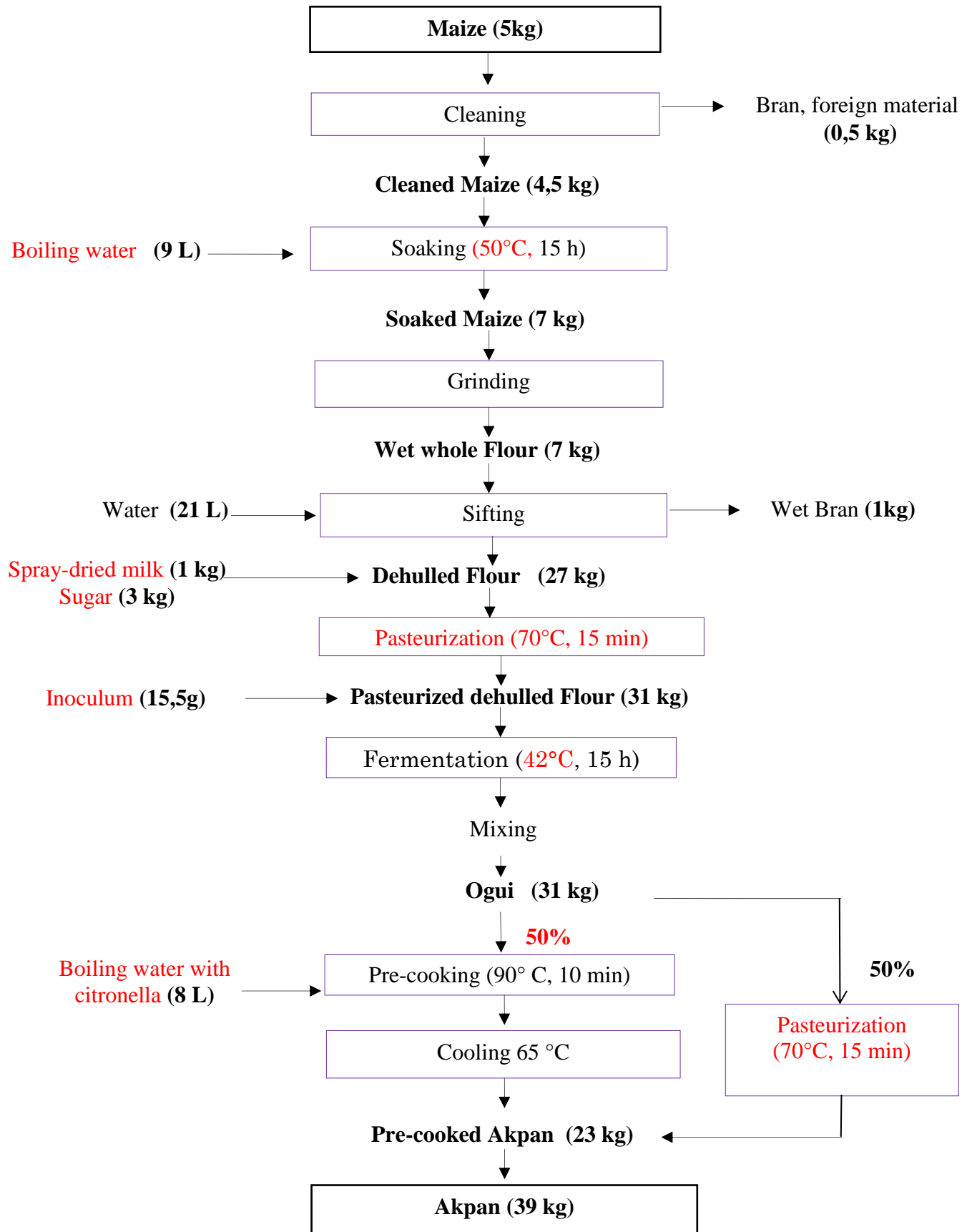
1. Akpan added with sugar (10%): AS10
2. Akpan added with spray-dried milk (3%) and sugar (8.7%): AMS8.7
3. Akpan added with spray-dried milk (3%) and sugar (15%): AMS15 (Benin reference)

2.3.3 Ethical assessment and consent

The studies have been assessed and approved by the University of Greenwich Research Ethics Committee and the Ethics Committee at CIRAD. Consent was sought from sensory panellists and from adult consumers participating in this study. Enumerators informed participants about the study and explained that their participation was entirely voluntary, that they could stop the interview at any point and that the responses would be anonymous.

AFTER (G.A n°245025) – Deliverable 5.4.2.1

Report on near-market consumer testing of new improved products in Europe for Group 1



2.3.4 Consumer evaluation methods

French consumer acceptability of Akpan was performed at Cirad Laboratory of Sensory Analysis in Montpellier with 102 consumers. No information about the product was provided to consumers beforehand. An announcement was sent some days before and on the morning to invite consumers to come and taste “a new type of yoghurt”. A beautiful reward was given to each participant to thank them for coming and for taking time during their working time.

The questionnaire was developed using on-line survey software Qualtrics. Ten computers were provided by our IT department. Each consumer follows instructions step by step by clicking with the mouse on the screen, and begins by answering a questionnaire (personal information, consumption habits) before tasting each Akpan product, one after the other, in a specific random order (30ml in a small clear plastic glass with a little spoon).

Consumers were asked to score the overall liking of each product using a nine-point hedonic scale (1. “Extremely dislike, 9. “Extremely like”) and to precise how they perceived texture, taste, odour, sweetness & acidity of the products, by using a 3-point JAR scale (1 = “Extremely low than I like”, 2= “Just About Right” and 3 = “Extremely high than I like”). They were also asked to answer a Check-All-That-Apply (CATA) (Ares et al., 2010; Dooley et al., 2010) table including 20 sensory and 8 perceptions descriptors that have been mentioned in focus groups previously conducted in France and in Benin on traditional maize Akpan products (Fliedel et al., 2013 ; Akissoë et al., 2014). Consumers were invited to put a tick/mark in front of the descriptors appropriated to better describe each Akpan sample. Finally they were asked to give their willingness to consume the product and their views about the more appropriate packaging by ranking in a decreasing order of preference the 6 pictures of packaging proposed.

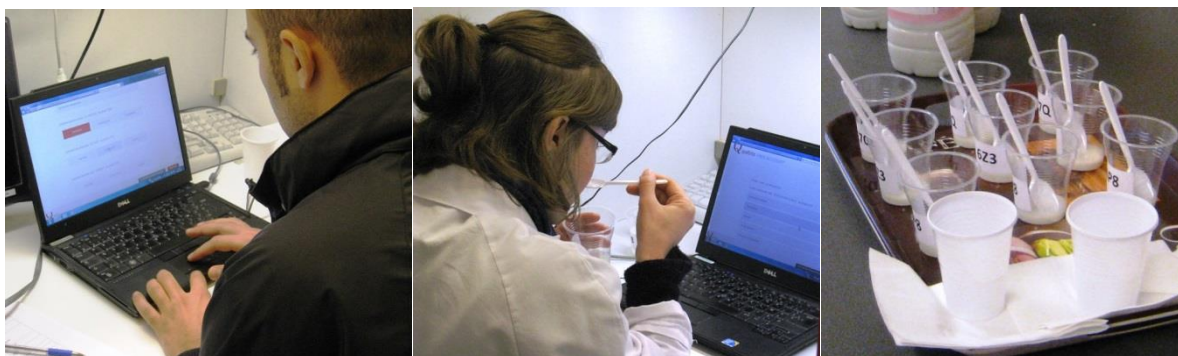


Figure 1. Consumer testing of Akpan in Cirad, Montpellier, France

2.3.6 Statistical analysis

Analysis of variance (ANOVA), Chi Square test ($p < 0.05$), cluster analysis (Ward's method) were carried out. Multiple pairwise comparisons were undertaken using the Tukey test with a confidence interval of 95%.

For the CATA study, frequencies of citation for each descriptor were determined by counting the number of consumers that checked each descriptor for describing Akpan product. Cochran's Q test was carried out for each of the 28 descriptors to evaluate if the CATA method was able to detect differences in consumers' perception for the three Akpan products. A Principal Component analysis (PCA) was performed on CATA responses for each category of descriptors in order to identify relationships between sensory descriptors & perceptions and Akpan products, and to get a sensory map of the products.

All statistical analyses were performed using XLSTAT 2014 (Addinsoft).

2.4 Akpan Results and discussion

2.4.1 Consumer acceptance of Akpan products

The overall acceptability of Akpan products did not significantly differ between the three samples (one-way ANOVA). No difference was observed among the three products regarding their overall acceptability (Tukey test with a confidence interval of 95%). (Table 1). All of them had an average score around 5 (neither like nor dislike).

Table 1 - Mean overall liking scores for the three Akpan tested

Category	Average Global Appreciation	Groups
AMS15	5.441	A
AS10	5.275	A
AMS8.7	4.990	A

*Acceptability was rated on a nine-point scale from 1 = dislike extremely, to 9 = like extremely. Different letters are significantly different samples. Tukey test ($p < 0.01$). Where Akpan added with 10% sugar (AS10), Akpan added with 3% spray-dried milk and 8.7% sugar (AMS8.7), Akpan added with 3% spray-dried milk and 15% sugar (AMS15).

2.4.2 Segmentation of consumers into groups of similar acceptance patterns regarding the Akpan products

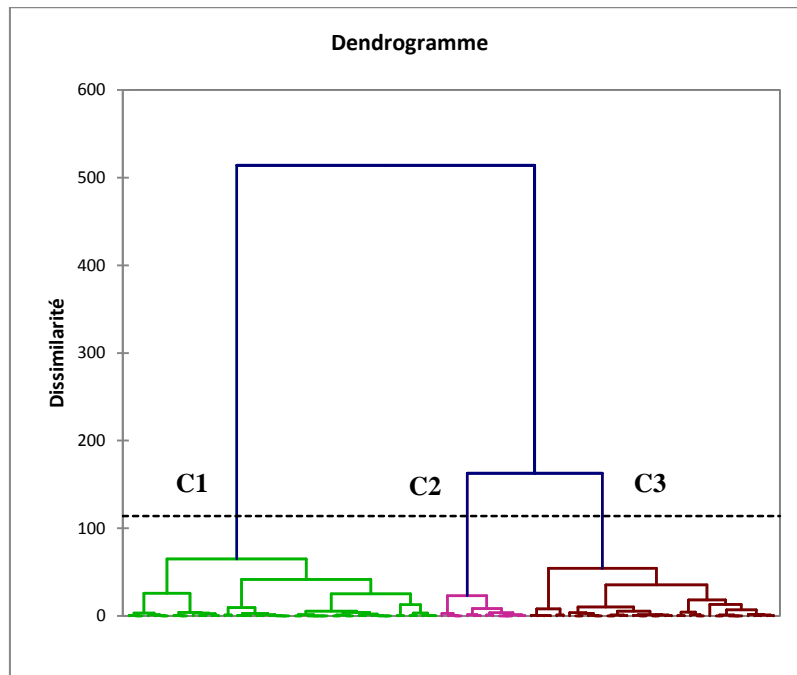


Figure 2. Dendrogram clustering Akpan consumers on their overall acceptance patterns
By using a hierarchical cluster analysis of the overall liking scores, we identified three groups of consumers: the Akpan indifferent likers (48%), the too sweet Akpan dislikers (38%) and Akpan dislikers (14%). There were significant differences ($P < 0.001$) in the overall liking of the clusters (Figure 2 and Figure 3).

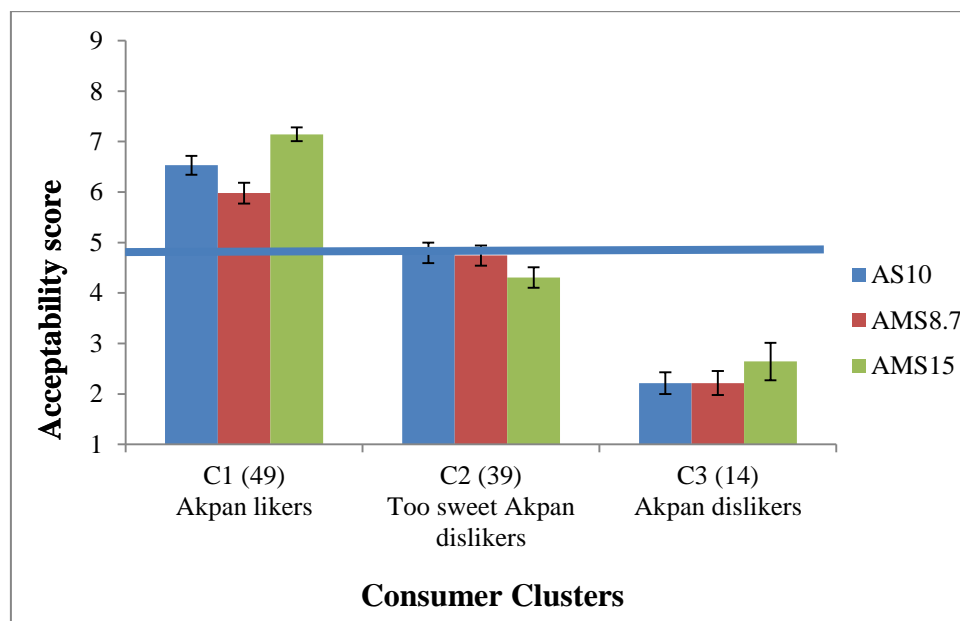


Figure 3. Mean consumer acceptance of Akpan by cluster type

Where: error bars represent the standard error. Where Akpan added with 10% sugar (AS10), Akpan added with 3% spray-dried milk and 8.7% sugar (AMS8.7), Akpan added with 3% spray-dried milk and 15% sugar (AMS15).

AFTER (G.A n°245025) – Deliverable 5.4.2.1

Report on near-market consumer testing of new improved products in Europe for Group 1

Table 2. Demographic differences of the consumers with respect to cluster division

	p-value		Total	C1 Akpan likers	C2 Sweet Akpan dislikers	C3 Akpan dislikers
	Statistical test of independence (Khi ²)					
Gender	0.363	Number of consumers (n)	102	49	39	14
		Female (%)	56	49	64	57
		Male (%)	44	51	36	43
Age	0.901	18-35 years old (%)	22	22	23	14
		36-45 years old (%)	15	16	13	14
		46-55 years old (%)	41	37	41	57
		55-65 years old (%)	23	24	23	14
Education	0.161	Degree and less (%)	17	12	23	14
		High level degree (%)	25	22	33	7
		Graduated (%)	26	24	26	36
		Post Graduated (%)	32	41	18	43
Yoghurt consumption	0.185	Every day	30	27	36	29
		Once/several times a week	43	45	46	29
		Once/several times a month	23	20	18	43
		Rarely	4	8	0	0
Plant milk consumption	0.112	Every day	1	0	3	0
		Once/several times a week	8	8	8	7
		Once/several times a month	9	12	5	7
		Rarely	31	31	21	64
		Never	51	49	64	24

Among the 102 consumers interviewed, 56% were female and 44% male. 22% were 18-35 years old, 15% were 36-45 years old, 41% were 46-55 years old and 23% were 55-65 years old. Most of them had a high level of education: 25% had a higher degree (2 or 3 years after degree), 26% were graduated (5 years after degree: master or engineer) and 32% were post graduated (8 years after the degree and more: PhD and HDR).

The three clusters did not significantly differ in terms of sociological characters such as gender, age or level of studies ($p < 0.05$).

2.4.3 Consumption attitudes

Most of consumers interviewed were used to consume yoghurts (0% of « never » and 4% of “rarely” answers). 43% are used to consume yoghurts several times a week, 30% every day and 23% once or several times a month.

Main reasons cited were pleasure (76% of answers), nutritious and healthy (49 and 37% respectively), and then habit (28%) and refreshing (22%).

At the question “Do you consume some “plant” milk such as soy milk or rice milk, people answered “never” at 51% or “rarely” at 31%. Only 1% of interviewees consume this type of milk every day and only 8% once or several times a week.

For people who are used to consume “plant” milk, the main reasons given were health (50%), pleasure (44%), nutritious (34%) and easy to digest (34%).

2.4.4 Just About Right

Just about right (JAR) scale was used to determine the optimum level of intensity for some sensory attributes of Akpan products. Such “attribute diagnostic” may help to understand why consumers like or dislike this product. Consumers were asked to precise how they perceived texture, taste, odour, sweetness & acidity of each Akpan product, by using a 3-point JAR scale (1 = “Too low than I like”, 2= “Just About Right, as I like” and 3 = “Too high than I like”).

Whatever Akpan product tasted, consumers were satisfied with its acidity or sweetness. These two attributes were scored “Just About Right, as I like” by 56 to 77% of consumers.

Odour was perceived differently, depending on the consumers. Some of them found Akpan odour “Too weak” (22 to 32% of answers) or “Just About Right, as I like” (33 to 40%), or “Too strong” for 34 to 38% of them.

Texture was found “Too weak”, too liquid by the majority of consumers (49 to 55%), mainly for Akpan added with sugar (53% and 55% for AMS8.7 and AMS15 respectively). It was considered “Just About Right” by 41 to 47% of consumers and only few persons (2 to 4%) checked it “too high”, too compact.

Taste of Akpan products was evaluated “too strong” by most of people (46 to 54%).

AFTER (G.A n°245025) – Deliverable 5.4.2.1

Report on near-market consumer testing of new improved products in Europe for Group 1

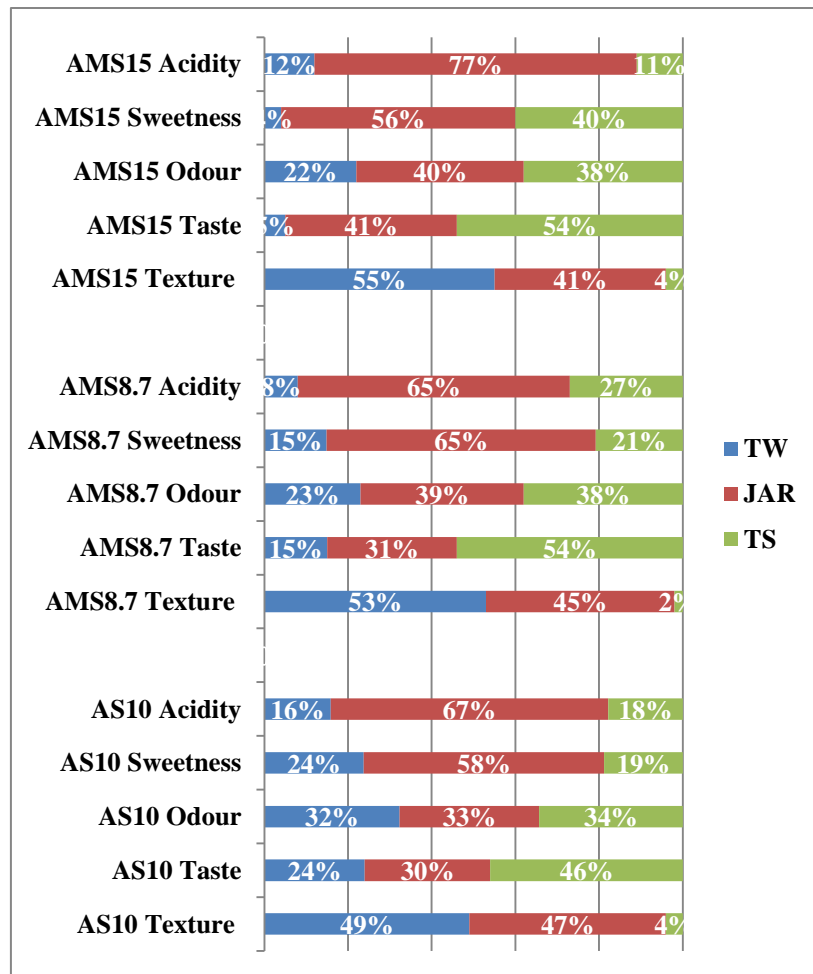


Figure 4. Intensity of some sensory descriptors perceived by French consumers for each Akpan product using a JAR Scale

Where JAR Scale : too weak (TW), JAR (Just About Right, as I like) and too strong (TS) and where Akpan added with 10% sugar (AS10), Akpan added with 3% spray-dried milk and 8.7% sugar (AMS8.7), Akpan added with 3% spray-dried milk and 15% sugar (AMS15).

2.4.5 Check-All-That-Apply Question

After scoring the acceptance and JAR intensity, consumers were invited to choose the most appropriate words among 20 sensory descriptors and eight perception descriptors to best describe each Akpan product. No significant difference (one-way ANOVA $P > 0.001$) was observed in the frequency of citations used by consumers to describe each Akpan product, as shown in Table 3.

The most frequently selected descriptors were considered as the best for describing the products. They were the following : “Artificial”, “Floral”, “New/Different”, “Strong in Taste”, “Mealy” with a frequency of citation between 125 and 100, followed by “Liquid”, “Drinking yoghurt”, “Sweet”, “Acidic”, “Rough”, “Homogeneous”, “Refreshing” with a frequency of citation between 100 and 50. The least used term was “Attractive”, “Good for Health”, “Neutral/Nature”, “Thick”, “Lumps”, “Nutritious” and “Natural”.

AFTER (G.A n°245025) – Deliverable 5.4.2.1

Report on near-market consumer testing of new improved products in Europe for Group 1

Table 3. Frequency of descriptor citations for each Akpan product (Check-All-That-Apply method)

		AS10	AMS8.7	AMS15	Ideal Yoghurt	Frequency	Frequency /category	Average Frequency/ category
Sensory descriptors	Liquid	18	32	37	3	87	981	16.35
	Bulgarian yoghurt	11	7	9	36	27		
	Lumps	3	4	6	0	13		
	Neutral	6	3	2	22	11		
	Soya	8	6	9	6	23		
	Sweet	22	19	43	29	84		
	Cereals	16	7	10	11	33		
	Floral	38	30	36	15	104		
	Acidic	10	32	15	11	57		
	Fermented	3	13	8	10	24		
	Sour	8	17	7	2	32		
	Milk Taste	2	11	4	26	17		
	Tasteless	16	8	3	1	27		
	Strong in Taste	30	33	38	11	101		
	Mealy	33	32	35	1	100		
	Watery	23	6	10	1	39		
	Thick	7	2	4	30	13		
	Creamy	17	12	17	70	46		
	Homogeneous	16	18	22	42	56		
	Drinking yoghurt	22	33	32	10	87		
Perceptions	New/Different	35	35	34	16	104	384	16.00
	Refreshing	21	11	23	48	55		
	Natural	4	4	7	51	15		
	Artificial	42	38	43	1	123		
	Rough	17	25	15	0	57		
	Nutritious	5	5	5	25	15		
	Good for Health	3	2	3	50	8		
	Attractive	3	1	3	27	7		
Overall Appreciation		5	5	5				
Frequency/sample		439	446	480	555			
Average Frequency/sample		15.68	15.93	17.14	19.82			

The frequent citation of the terms “Artificial”, “Floral”, “New/Different”, “Strong in Taste”, for each Akpan product, may find an explanation: essential oil drops of citronella were used in place of citronella infusion during pre-cooking of Akpan. They have taken over the real taste of Akpan, masking probably specific sensory characteristics and limiting a better acceptance of the product. A majority of people found citronella taste and odour too strong. However, the terms that followed well characterized the product and were certainly more easily checked by consumers who are used to consume other “plant” milk.

AS10, Akpan added with 10% sugar, was described as artificial (42 citations), floral (38), new/different (35), mealy (33), with a strong taste (30), watery (23), with a texture of a drinking yoghurt (22), sweet and refreshing (22 and 21 citations respectively).

Consumers used the same descriptors to describe AMS8.7, Akpan added with 3% spray-dried milk and 8.7% sugar, with almost the same frequencies of citation. AMS8.7 was not perceived refreshing (11 citations only) but it was qualified liquid (32 citations), acidic (32) and rough (25).

AMS15, Akpan added with 3% spray-dried milk and 15% sugar, the sweeter Akpan, was also considered as artificial by consumers (43 citations), sweeter (43 citations), strong in taste (38), liquid (37), floral (36), mealy (35), new/different (34), with a consistency of a drinking yoghurt (32), and refreshing and homogeneous (23 and 22 citations respectively).

Higher proportions of sugar usually give more liquid consistency and reduce acidity of the products. Consumers' answers confirmed this tendency.

At the end of the questionnaire, consumers were asked to kindly describe an ideal yoghurt on their point of view using the same CATA descriptors than already used for describing the three Akpan products. No significant difference (one-way ANOVA $P > 0.001$) was observed in the number of citations used by consumers to describe an ideal yoghurt and each Akpan product, as shown in Table 3. However, if the frequency of citations is almost the same, the descriptors chosen were completely different for a "perfect" yoghurt compared to those chosen for Akpan products.

The "ideal" yoghurt was described as creamy (70 citations), natural (51 citations), good for health (50), refreshing (48), homogeneous (42), with a texture of a Bulgarian yoghurt-type (36), thick (30), sweet (29), attractive (27), with a milk taste and nutritious (26 and 25 citations respectively). None of these descriptors was used to describe Akpan products unless refreshing, homogeneous and sweet with a lower frequency of citation.

Principal component analysis (PCA) was used to summarize the relationships between sensory characteristics of CATA task and Akpan samples. The PCA plot in Figure 4, explained 100% of the variance, the first and second axes accounting for 61.32% and 38.68% respectively. Regarding perception descriptors of CATA task, the two first axes of PCA

AFTER (G.A n°245025) – Deliverable 5.4.2.1

Report on near-market consumer testing of new improved products in Europe for Group 1 explained 100% of the variance, the first and second axes accounting for 83.69% and 16.31% respectively. Most of the variance was explained by the first axis.

The loading of sensory descriptors on PCA plan (Figure 4a) shows that axis 1 was mainly explained by the terms such as Cereals, Watery, Bulgarian yoghurt, Thick, Floral, Neutral, and Tasteless, related to AS10 Akpan (with no milk and 10% sugar) and negatively by the terms such as Fermented, Drinking yoghurt, Acidic, Milk Taste, Liquid and Sour, related to AMS 8.7 Akpan (added with milk and 8.7% sugar). Axis 2 was mainly explained by the terms such as Strong in Taste, Soya, Homogeneous, Creamy, Lumps, Mealy, and Sweet, related to AMS 15 Akpan (added with milk and 15% sugar).

The loading of perception descriptors on the PCA plan (Figure 4b) shows that axis 1 was mainly explained positively by the term such as Refreshing, Artificial, Good for Health and Attractive related to AMS 15 Akpan (added with milk and 15% sugar) and negatively by the terms Rough related to AMS 8.7 Akpan (added with milk and 8.7% sugar). Axis 2 was mainly explained positively by the term New/Different related to AS10 Akpan (with no milk and 10% sugar) and negatively by the term Natural.

AFTER (G.A n°245025) – Deliverable 5.4.2.1

Report on near-market consumer testing of new improved products in Europe for Group 1

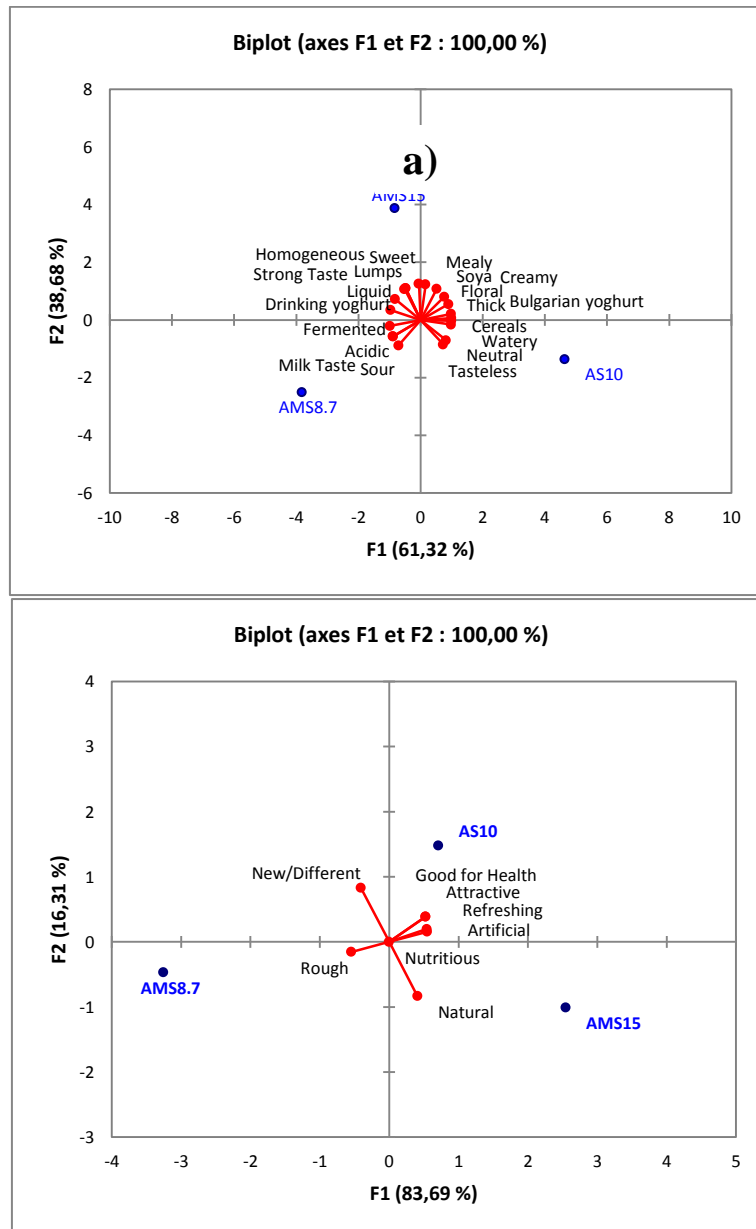


Figure 5. PCA on CATA descriptors: Projection of sensory descriptors a) and projection of perception descriptors b) with Akpan products. Where Akpan added with 10% sugar (AS10), Akpan added with 3% spray-dried milk and 8.7% sugar (AMS8.7), Akpan added with 3% spray-dried milk and 15% sugar (AMS15).

2.4.6 Willingness to consume Akpan products

After checking CATA descriptors, consumers were invited to answer to the question “How likely would you buy and consume this product” for each Akpan product.

Whatever the product, similar answers were given: no chance for 23-24% of consumers interviewed to consume this type of yoghurt, very low possibilities for 11 to 20%, and low possibilities for 22 to 26%. Some possibilities were given to AS10 (11%) et AMS15 (14%)

AFTER (G.A n°245025) – Deliverable 5.4.2.1

Report on near-market consumer testing of new improved products in Europe for Group 1 and good opportunity for AMS8.7 (11%). Only 5% would definitively buy and consume AMS15 Akpan product, Akpan added with milk and 15% sugar.

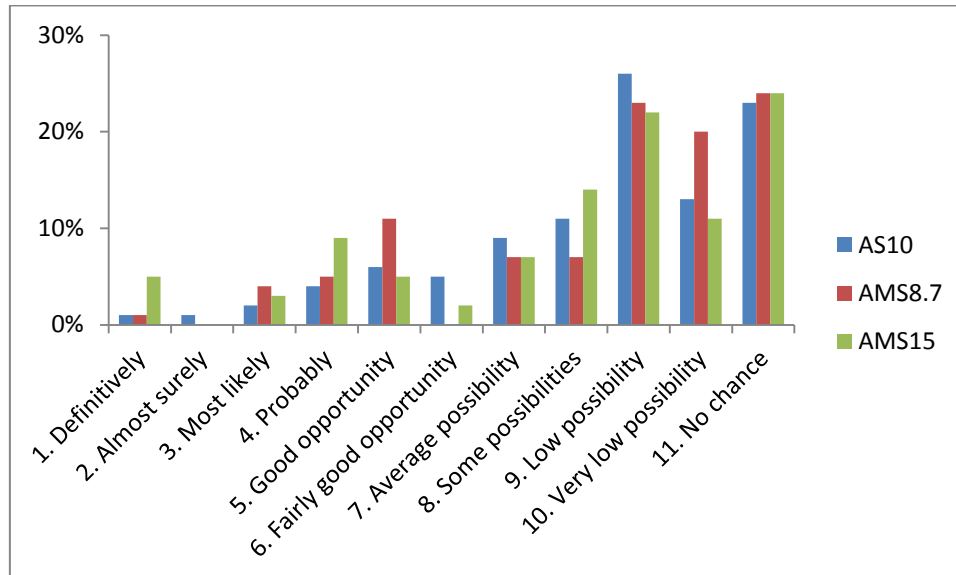


Figure 6. Willingness to consume Akpan products

Where Akpan added with 10% sugar (AS10), Akpan added with 3% spray-dried milk and 8.7% sugar (AMS8.7), Akpan added with 3% spray-dried milk and 15% sugar (AMS15).

2.4.7 Suitable packaging for Akpan product

At the end of the questionnaire, various pictures of yoghurt packaging were proposed and consumers were invited to rank in decreasing order of preference the type of packaging they would like for this type of "yoghurt" : from position 1 for the packaging the most appropriate, down to position 6 for the packaging the least appropriate.

Among the six pictures of packaging proposed, consumers chose in first position the picture of "stirred organic yoghurt" (31%) a tetrapack of a nature soymilk in second position (20%), in third position the packaging of a bulgarian yoghurt-type (17%), then of a drinking yoghurt (15%), another stirred yoghurt in a larger packaging (10%) and finally the packaging of greek yoghurt-type (at 8 % only) in sixth position.

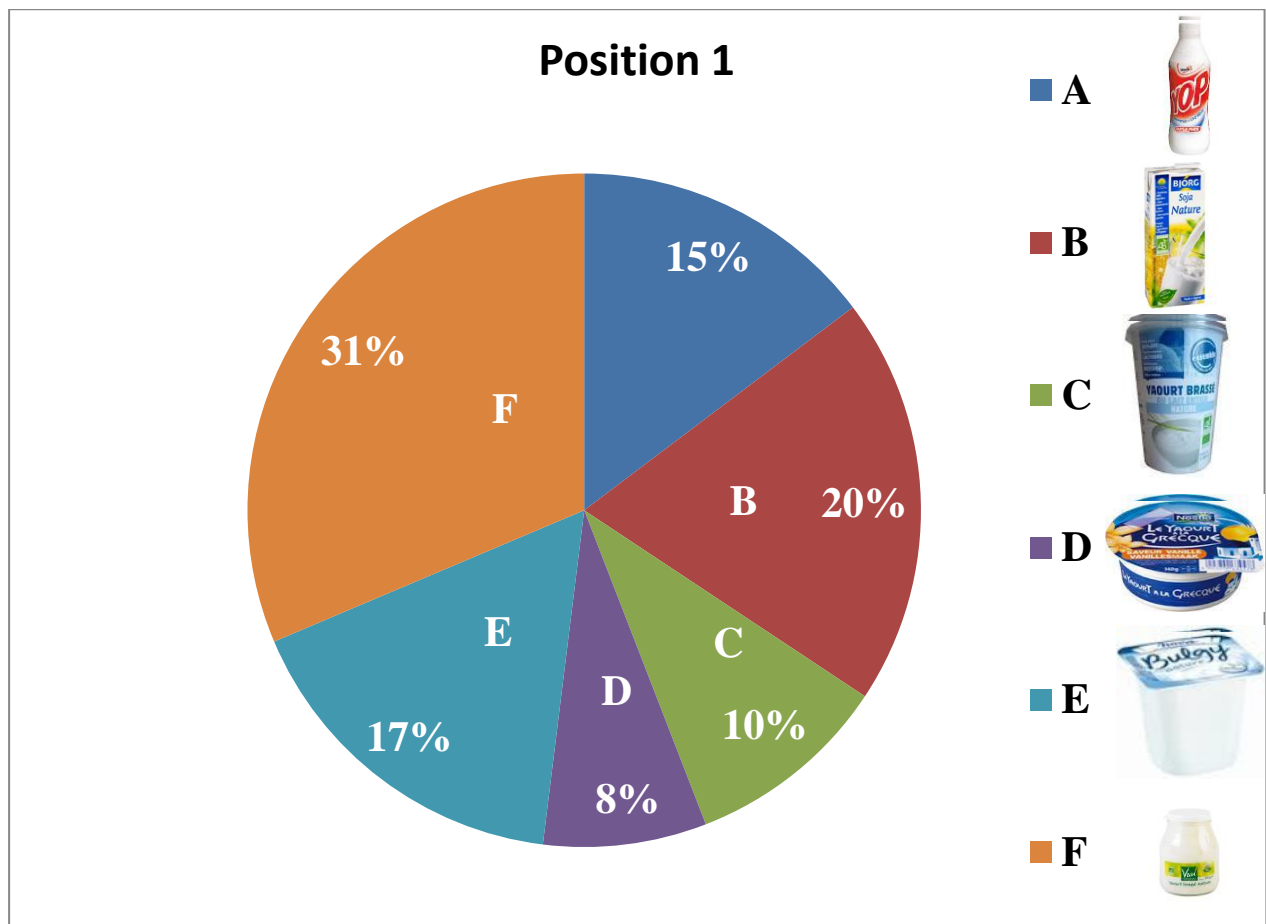


Figure 7. First choice for an appropriate packaging for Akpan product

2.5 Akpan Conclusions

The three Akpan products were not perceived differently by French consumers. Even if they have an average acceptability, only few people would likely buy it. The re-engineered product was not more acceptable than the traditional one (Fliedel et al., 2013) which was also scored around 5.

If we remove the terms such as “artificial”, “strong in taste”, “floral” due to a manufacturing error (use of a few drops of citronella essential oil instead of citronella infusion as a traditional flavouring of Akpan in Benin), it remains the terms “mealy”, “liquid” “drinking yoghurt” that better describe the product and were previously used for describing traditional Akpan product. This means that sensory properties of traditional Akpan were not totally improved during re-engineering to meet French consumer taste.

Re-engineering has focused primarily on improvement of sanitary properties of the product, which was a great achievement and will allow producing Akpan on a larger scale in SMEs in

Africa. However, to meet expectations of French consumers who would like a creamy, homogeneous, bulgarian yoghurt-type product, Akpan texture needs to be improved. It must be less liquid, creamier and not mealy. The proportion of uncooked Ogui added to cooked Ogui (to avoid a too thick consistency after starch gelatinization) must be modified, or another alternative must be proposed to reduce consistency of whole cooked Ogui and suppressing mealy sensation, while maintaining its creaminess.

2.6 Acknowledgement

This publication is an output from a research project funded by the European Union (FP7 245–025) called African Food Revisited by Research (AFTER - <http://www.after-fp7.eu/>). The views expressed are not necessarily those of the European Union. We are grateful to AQMC (Analyses Qualité Microbiologie Conseil), the laboratory of microbiological analyses in Montpellier, for performing the sanitary characteristics of the Akpan products.

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3. Consumer preference study of Kenkey reengineered products in Europe

3.1 Kenkey Summary

The results of this research help to provide a basis of understanding on how the reengineered Kenkey (RK) compares to standard commercial Kenkey (SK) in terms of its acceptability by consumers in Europe. Consumers scored differently the new product from the standard one: the average liking for the standard Kenkey was 4.2 ± 2.0 (dislike slightly) and reengineered Kenkey was 5.0 ± 1.9 (neither like nor dislike). Most consumers (76%) interviewed were not familiar with Kenkey products in general and this significantly affected the acceptability of the product. Although the reengineered product was preferred to the standard Kenkey, the acceptability was not very high and shows that on average the products were not very appealing to the consumers interviewed. There were three different classes of consumers: a) those who did not like Kenkey products; they were called 'Kenkey dislikers' (45%); b) those who liked the reengineered product (RK); they were called 'RK likers' (21%); and c) those who accepted the two Kenkey products with a slight preference for the standard Kenkey (RK); they were called 'Kenkey likers (35%)'. Cluster classification was not influenced by sociological factors such as age, gender, education level, occupation and ethnicity (African, European or other) but it was influenced by the familiarity with Kenkey products. In conclusion although RK has improved acceptance compared to SK, the acceptance is not high enough for it to be ready to be marketed. Kenkey product appears to be an unfamiliar product for most consumers with sensory properties that are different and therefore not appealing for most European consumers.

3.2 Kenkey Background

Kenkey is a major form of maize consumption in Ghana. It presents as dumpling made from fermented maize dough, which is wrapped in maize husks and boiled. Surveys were undertaken to understand what type of reengineered Kenkey should be produced for the international market. A survey of the production and consumption of different types of Kenkey, review of regulatory opportunities, value chain analysis, chemical, textural and microbiological analysis, and sensory and consumer tests were carried out (Amoa et al. 2012). Sensory preference for European consumers showed that reengineered Kenkey should be mild, less acidic, with a bland taste, white colour and soft textured (Amoa et al. 2012). Nsiho

or white Kenkey made from dehulled maize grains was, therefore, selected for reengineering. *L. plantarum* and *S. cerevisiae* were tested as starter culture for white Kenkey. Attempts to package Kenkey in sausage casing rather than maize husks were not successful. Moulding into cylindrical shapes rather than the traditional round balls has been attractive to consumers (Amoa et al. 2012). This deliverable presents the results of consumer testing of Standard Kenkey (Ga Kenkey) compared to Reengineered Kenkey (reengineered Nsiho Kenkey).

3.3 Kenkey Methodology

3.3.1 Ethical assessment and consent

The studies have been assessed and approved by the University of Greenwich Research Ethics Committee and the Ethics Committee at CIRAD. Consent was sought from sensory panellists and from adult consumers participating in this study. Enumerators informed participants about the study and explained that their participation was entirely voluntary, that they could stop the interview at any point and that the responses would be anonymous.

3.3.2 Consumer evaluation methods

The reengineered Kenkey was processed following methods developed by Charlotte Oduro-Yeboah (Amoa et al. 2012). The processing was conducted under controlled conditions at CIRAD, France by Charlotte and described in the appendix 1. The reengineered Kenkey under vacuum sealed bags was shipped to the UK in a polystyrene box containing freeze gel. The box arrived in good condition and the samples were still cold upon arrival. The standard Kenkey (commercial Ga Kenkey) was bought in an African shop in Gillingham, UK. Both Kenkey products were stored in the fridge between experiments. The samples are presented in the figure 1 below.



Figure 1. Reengineered Kenkey (left) (RK) and standard commercial Kenkey (SK) (right)

AFTER (G.A n°245025) – Deliverable 5.4.2.1

Report on near-market consumer testing of new improved products in Europe for Group 1

The total quantity of samples was:

- 9 bags of reengineered Kenkey (RK) (each bag containing 10 balls of Kenkey) made from Ghanaian white maize in CIRAD, France
- 4 packs of standard commercial Kenkey (SK) (each pack containing 2 blocks enwrapped in maize leaves) (Ghana Best Ga Kenkey produced by Odeisis Foods Ltd & distributed by Wanis Ltd, UK).

Kenkey products were heated to at least 75°C (core temperature) in the microwave prior to consumption. Whilst still hot, the products were sliced into small portions of approx. 20g. The sliced samples were brought to the canteen where the food was served to consumers (Figure 2).



Figure 2. Preparation of the Kenkey samples: Checking of product core temperature – Slicing of the products – Preparation of samples for transportation- Coding of the samples on plates- Preparation of samples on plates - Poster

At each session, Kenkey samples (coded with 3-figure random numbers) were served on a white plate. Kenkey products were tested blind by consumers and the order in which they were presented was randomised. The only information given to the consumer about the products is that they were made of maize and had been fermented.

Consumers (n=121) were interviewed at the University of Greenwich, Medway campus in the Pilkington building (canteen). Consumers were randomly invited to participate in the tasting of the samples. The questionnaire was presented on an android tablet using KOBO software.

AFTER (G.A n°245025) – Deliverable 5.4.2.1

Report on near-market consumer testing of new improved products in Europe for Group 1

Consumer testing was carried out on two samples previously described and served at ambient temperature (cold). During acceptability testing, each consumer was invited to taste the samples presented in random order and coded with three figure random numbers. Consumers were asked to score the acceptability with respect to appearance, taste and overall liking using a nine-point verbal hedonic box scale which varied from dislike extremely to like extremely (Meilgaard *et al.* 2007) (Figure 3).



Figure 3. Samples ready for consumer testing and consumers and enumerators in action

Along with obtaining information about the acceptability of the Kenkey products, information was elicited from each consumer regarding demographics, education, and consumption and buying. A CATA (Check All That Applies) and a JAR (Just About Right) tests were also included to help describe the samples' attributes and feelings associated. These are relatively novel techniques that have been more commonly used in consumer testing over the last years. The techniques are very useful to describe the characteristics of the products from a consumer side. Trained enumerators answered questions from the consumers when required. The interview procedure lasted no more than 10 min.

3.3.3 Statistical Analysis

Analysis of variance (mixed effect model), correlation analysis (Pearson), Chi-squared analysis and principal component analysis (correlation matrix) were carried out using SPSS (V 20.0) or XLSTAT (V 5.2, Addinsoft). Hierarchical cluster analysis (Wards method) was used to segment the consumers interviewed at the different locations into three different groups. Segmentation gives a more complex variation in acceptability among the consumers and is helpful to understand differences in consumer behaviour. Multiple pairwise comparisons were undertaken using the Tukey test with a confidence interval of 95%.

3.4 Kenkey Results and discussion

Overall consumer acceptance of Kenkey products

Overall acceptance of the two Kenkey products differed significantly at $p < 0.01$ (One-way ANOVA). The average liking for the standard Kenkey was 4.2 ± 2.0 (dislike slightly) and reengineered Kenkey was 5.0 ± 1.9 (neither like nor dislike). Although the reengineered product was preferred to the standard Kenkey, the acceptability was not very high and shows that on average the products were not very appealing to the consumers interviewed.

Segmentation of consumers into groups of similar acceptance patterns regarding the Kenkey products

In second place, hierarchical cluster analysis (HCA) (Wards Method) was applied to find out about the different groups of acceptance of Kenkey. HCA indicated three different groups of consumer profile with respect to the Kenkey products (Figure 4).

AFTER (G.A n°245025) – Deliverable 5.4.2.1

Report on near-market consumer testing of new improved products in Europe for Group 1

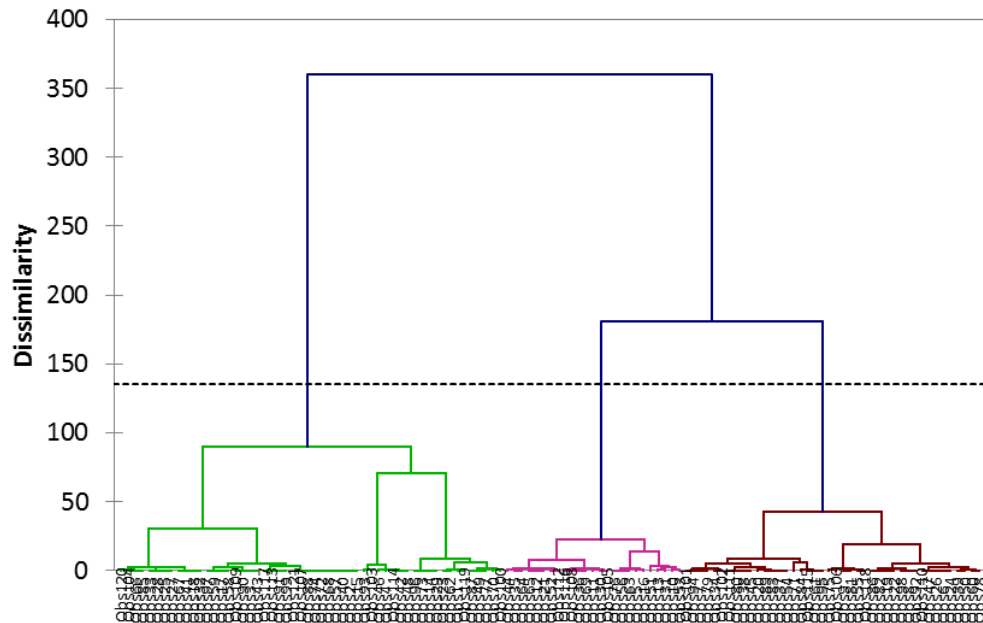


Figure 4. Dendrogram showing the segmentation of different liking groups

The mean liking for each of the three groups is illustrated in Figure 5. We used a score of five ‘neither like nor dislike’ as an indicator of “neutral attitude”. Rating below five was considered as “disliking” and above five as “liking”.

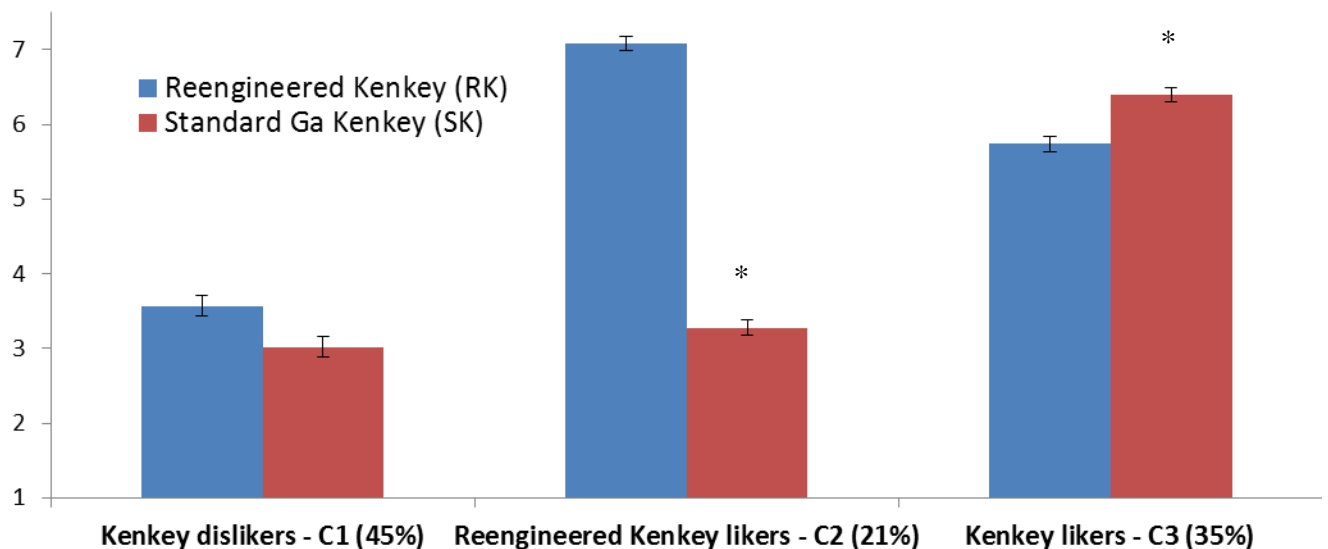


Figure 5. Cluster segmentation of different groups of liking.

* indicates that there are significant differences between the two products within the same cluster.

For the purposes of cluster division, the groups were grouped as ‘Kenkey dislikers’ C1 (45%), ‘Reengineered Kenkey likers’ C2 (21%) and ‘Kenkey likers’ C3 (35%). A difference between acceptability of the two Kenkey products was found for C2 and C3.

AFTER (G.A n°245025) – Deliverable 5.4.2.1

Report on near-market consumer testing of new improved products in Europe for Group 1

Cluster analysis approach has been commonly used in consumer acceptance in order to determine which groups of people who would prefer which type of product. This approach is very useful in the marketing approach because it helps target specific consumers with the type of product they like. The liking can be depended upon many factors (socio-economic background; food customs) and knowing the consumers would help predict the product that they are more likely to adopt when launching a new product on the market for instance.

Influence of socio-demographic factors and willingness to pay for Kenkey on cluster division
Demographic differences and consumer attitudes to Kenkey with respect to cluster division were calculated at $p < 0.05$ (Table 1).

AFTER (G.A n°245025) – Deliverable 5.4.2.1

Report on near-market consumer testing of new improved products in Europe for Group 1

Table 1. Demographic differences and consumer attitudes to Kenkey with respect to cluster division

Question		C1 'Kenkey dislikers'	C2 'Reengineered Kenkey likers'	C3 'Kenkey likers'	Probability ^a One-way ANOVA (p<0.05) ^b Chi Square test (p<0.05)
Number of interviewees		54	25	42	
Female		48.1%	44.0%	33.3%	0.338 ^b
Male		51.9%	56.0%	66.7%	
Age (years)	18-20	31.5%	24.0%	16.7%	0.797 ^b
	21-29	31.5%	40.0%	33.3%	
	30-39	11.1%	12.0%	14.3%	
	40-49	7.4%	8.0%	7.1%	
	50-64	18.5%	12.0%	26.2%	
	65 or older	0.0%	4.0%	2.4%	
Education	GCSC	9.3%	0.0%	0.0%	0.058 ^b
	A-level	38.9%	56.0%	31.0%	
	BSc or BA	29.6%	12.0%	23.8%	
	MSc or MA	14.8%	20.0%	26.2%	
	PhD	7.4%	12.0%	19.0%	
Occupation	University student	70.4%	76.0%	54.8%	0.438 ^b
	University staff	25.9%	24.0%	38.1%	
	Professional outside university	0.0%	0.0%	2.4%	
	Other	3.7%	0.0%	4.8%	
Ethnic origin	European	75.9%	56.0%	66.7%	0.186 ^b
	African	3.7%	24.0%	14.3%	
	Other	18.5%	20.0%	19.0%	
Have you eaten this product before?	Yes	11.1%	44.0%	28.6%	0.004* ^b
	No	88.9%	56.0%	71.4%	
If a similar product than RK was available on the market, will you be willing to buy it?	Unlikely	79.6%	20.0%	42.9%	<0.001* ^b
	Neither likely nor unlikely	13.0%	20.0%	26.2%	
	Likely	7.4%	60.0%	31.0%	
If a similar product than SK was available on the market, will you be willing to buy it?	Unlikely	90.7%	88.0%	28.6%	<0.001* ^b
	Neither likely nor unlikely	9.3%	8.0%	33.3%	
	Likely	0.0%	4.0%	38.1%	
Maximum price (£) people are willing to pay	for RK	0.94a	2.04b	1.50ab	<0.001* ^a
	for SK	0.87a	1.12a	2.05b	<0.001* ^a

*significant at p<0.05

The three clusters did not significantly differ in terms of sociological criteria such as age, gender, education level, occupation and ethnic (African, European or other) origin. However there were differences in the clusters in their exposure to the product: 89% of 'Kenkey dislikers' (C1) had never eaten Kenkey before but only half (56%) of 'Reengineered Kenkey likers' (C2) had never had Kenkey before. Product exposure has been found to be strongly linked to acceptability. Neophobia is the fear of eating non-known or unfamiliar food and is strongly related to low food acceptance.

AFTER (G.A n°245025) – Deliverable 5.4.2.1

Report on near-market consumer testing of new improved products in Europe for Group 1

‘Willingness’ to pay for the products also differed between the clusters: Most ‘Kenkey dislikers’ (C1) were unlikely to buy either Reengineered Kenkey (RK) or Standard Kenkey (SK) (80% and 91%, respectively). In fact, none of the ‘Kenkey dislikers’ (C1) was likely to buy SK. On the other hand, only 29% ‘Kenkey likers’ (C3) were unlikely to buy SK and 60% ‘Reengineered Kenkey likers’ (C2) were likely to buy RK. Globally more people were willing to buy RK compared to SK, which is good news for the reengineering process.

People were asked how much they would pay for the product they have eaten compared to an initial suggested price of £2. Globally the intentional price was lower than the £2 price, which shows that the buying incentive was not high. The maximum price people were willing to pay for the Kenkey products also varied: globally ‘Kenkey dislikers’ (C1) were willing to pay less than the other clusters. C2 and C3 put a similar intentional price for RK but for SK, the price was significantly higher for C3. This can be explained because the acceptability of SK was much higher for C3 than for C2 (Figure 2). Overall the intentional prices were in accordance with the cluster classification.

Familiarity with Kenkey and similar products

Most consumers (76%) interviewed were not familiar with Kenkey. Consumers who had not eaten Kenkey before were asked which foods they knew were similar to Kenkey products they tasted. Most common products mentioned are listed below.

Table 2. Foods that are the closest to RK and SK according to the consumers.

What is the product similar to?	Count of food closest
Not clear	26
Rice	19
Bread	9
Rye Bread	3
Dough	3
Polenta	3
Potato	3
Tofu	3
Corn bread	2
Corn meal & starch	2
Kenyan product	2
Oat	2
Ugali	2
Angolan product	1
Coconut	1
Dumplings	1
Grain	1
Indian product	1
Maize tamal	1
Marmite on toast	1
Marzipan	1
Nigerian product	1
Porridge	1
Soy	1
Sri Lankan product	1
Sushi	1
Grand Total	92

Many consumers interviewed (26/92) did not know any similar product to SK and RK. Rice was the second most cited answer followed by bread (19 and 9 people, respectively). Rye Bread, dough and polenta were mentioned by 3 people each. Corn bread was also mentioned. Potato and Tofu were also mentioned (3/92 for both). Some people felt they had eaten something similar to Kenkey whilst travelling to Africa or Asia (Angola, Nigeria, Kenya, India, and Sri Lanka).

Some consumers compared the product to African products from maize (Agidi (Nigeria)). Two people thought that the product (i.e. RK) was similar to Ugali, a dough made from non-fermented maize flour and a staple food in Eastern Africa.

Globally the responses were very diverse and showed that most of the people interviewed were not familiar with Kenkey or similar products. The consumers who were familiar with SK and RK had on average higher acceptability especially for the reengineered product (5.9 versus 4.8 for RK and 4.6 versus 4.2 for SK).

3.5 Kenkey Conclusions

The results of this research help to provide a basis of understanding on how the reengineered Kenkey (RK) compares to standard commercial Kenkey (SK) in terms of its acceptability by consumers in Europe. In conclusion although RK has improved acceptance (5.0 on average) compared to SK (4.3 on average), the acceptance is not high enough for it to be ready to be marketed. In summary 55% of consumers interviewed liked RK (slightly or more) and 45% did not like it. Regarding the standard Ga Kenkey that had a stronger taste, 35% of people liked it (slightly or more) and 65% of people interviewed disliked it a lot. Overall Kenkey product appears to be an unfamiliar product for most consumers and therefore not appealing for most European consumers although it was liked by a fringe of the consumers interviewed.

3.6 Kenkey References

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Meilgaard, M., Civile, G. V., & Carr, B. T. (2007). *Sensory Evaluation Techniques* (4th ed.). Florida: CRC Press.

Annex 1 Kishk Sa'eedi consumer questionnaire

AFTER PT KISK

Q49



Q37 Muito obrigada por participar neste estudo de aceitabilidade, realizado no âmbito do projecto de investigação da União Europeia KBBE-2009-2-3-02. Os resultados permitirão uma melhor avaliação dos produtos em estudo no projecto. A informação individual será tratada de forma confidencial e os resultados deste estudo serão reportados sem que os seus dados pessoais sejam divulgados.

Q51 Ser-lhe-à pedido para avaliar 2 amostras de Kisk. O Kisk é um produto tradicional à base de leite fermentado e grãos de trigo moidos. Apresenta-se geralmente na forma de pequenas bolas secas ou nuggets, que são depois cozinhadas e se servem geralmente em guisados acompanhados de legumes.

Q95 As amostras de Kisk que vai provar foram preparadas respeitando todas as regras de higiene e segurança aplicáveis. Leia cuidadosamente as instruções à medida que forem aparecendo no ecrã do seu computador. Por favor não troque impressões com outras pessoas. Não existem respostas certas ou erradas, o importante é podermos obter a sua opinião pessoal. Note que, uma vez respondidas as questões, o software não lhe permitirá retornar aos ecrãs precedentes. Não hesite em solicitar ajuda se tiver alguma dúvida ou se precisar de qualquer tipo de assistência.

Obrigada

- ☐ Li e compreendi a informação acima e pretendo participar no estudo (1)
- ☐ Não pretendo participar no estudo (2)
- ☐

Q359 Por favor prove agora a amostra 243.

AFTER (G.A nº245025) – Deliverable 5.4.2.1

Report on near-market consumer testing of new improved products in Europe for Group 1

Q360 Globalmente, QUANTO GOSTOU da amostra 243?

- ☐ Gostei extremamente (1)
- ☐ Gostei muito (2)
- ☐ Gostei moderadamente (3)
- ☐ Gostei ligeiramente (4)
- ☐ Não gostei nem desgostei (5)
- ☐ Desgostei ligeiramente (6)
- ☐ Desgostei moderadamente (7)
- ☐ Desgostei muito (8)
- ☐ Desgostei extremamente (9)

Q39 O SABOR da amostra 243

- ☐ Demasiado fraco (1)
- ☐ x (2)
- ☐ Como gosto (3)
- ☐ x (4)
- ☐ Demasiado forte (5)

Q44 O TEMPERO a cominhos da amostra 243

- ☐ Demasiado fraco (1)
- ☐ x (2)
- ☐ Como gosto (3)
- ☐ x (4)
- ☐ Demasiado forte (5)

Q40 A TEXTURA da amostra 243

- ☐ Demasiado mole/homogénea (1)
- ☐ x (2)
- ☐ Como gosto (3)
- ☐ x (4)
- ☐ Demasiado dura/granulosa (5)

Q29 CONSUMIRIA a amostra 243, se ela estivesse disponível no mercado?

- ☐ 10- Sim (1)
- ☐ 9- É quase certo (2)
- ☐ 8- Muito provavelmente (3)
- ☐ 7- Provavelmente (4)
- ☐ 6- Boa possibilidade (5)
- ☐ 5- Possibilidade média (6)
- ☐ 4- Possibilidade razoável (7)
- ☐ 3- Alguma possibilidade (8)
- ☐ 2- Possibilidade ligeira (9)
- ☐ 1- Possibilidade muito ligeira (10)
- ☐ 0- Não (11)

AFTER (G.A n°245025) – Deliverable 5.4.2.1

Report on near-market consumer testing of new improved products in Europe for Group 1

Q406 Quanto estaria disposto(a) a pagar por uma refeição à base de Kisk (amostra 243) sabendo que este é um produto tradicional do Egipto?

- ☐ Muito menos do que outra refeição étnica a meu gosto(Mexicano,Indiano,...) (1)
- ☒ x (3)
- ☐ O mesmo (4)
- ☐ X (5)
- ☐ Muito mais do que outra refeição étnica a meu gosto(Mexicano,Indiano,...) (7)

Q401 Por favor prove agora a amostra 408.

Q402 Globalmente, QUANTO GOSTOU da amostra 408?

- ☐ Gostei extremamente (1)
- ☐ Gostei muito (2)
- ☐ Gostei moderadamente (3)
- ☐ Gostei ligeiramente (4)
- ☐ Não gostei nem desgostei (5)
- ☐ Desgostei ligeiramente (6)
- ☐ Desgostei moderadamente (7)
- ☐ Desgostei muito (8)
- ☐ Desgostei extremamente (9)

Q41 O SABOR da amostra 408

- ☐ Demasiado fraco (1)
- ☒ x (2)
- ☐ Como gosto (3)
- ☐ x (4)
- ☐ Demasiado forte (5)

Q42 O TEMPERO A COMINHOS da amostra 408

- ☐ Demasiado fraco (1)
- ☒ x (2)
- ☐ Como gosto (3)
- ☐ x (4)
- ☐ Demasiado forte (5)

AFTER (G.A n°245025) – Deliverable 5.4.2.1

Report on near-market consumer testing of new improved products in Europe for Group 1

Q43 A TEXTURA da amostra 408

- ☐ Demasiado mole/homogénea (1)
- ☐ x (2)
- ☐ Como gosto (3)
- ☐ x (4)
- ☐ Demasiado dura/granulosa (5)

Q28 CONSUMIRIA a amostra 408, se ela estivesse disponível no mercado?

- ☐ 10- Sim (1)
- ☐ 9- É quase certo (2)
- ☐ 8- Muito provavelmente (3)
- ☐ 7- Provavelmente (4)
- ☐ 6- Boa possibilidade (5)
- ☐ 5- Possibilidade média (6)
- ☐ 4- Possibilidade razoável (7)
- ☐ 3- Alguma possibilidade (8)
- ☐ 2- Possibilidade ligeira (9)
- ☐ 1- Possibilidade muito ligeira (10)
- ☐ 0- Não (11)

Q75 Quanto estaria disposto(a) a pagar por uma refeição à base de Kisk (amostra 408) sabendo que este é um produto tradicional do Egipto?

- ☐ Muito menos do que outra refeição étnica a meu gosto(Mexicano,Indiano,...) (1)
- ☐ x (3)
- ☐ O mesmo (4)
- ☐ X (5)
- ☐ Muito menos do que outra refeição étnica a meu gosto(Mexicano,Indiano,...) (7)

Q414 Em qual destas lojas esperaria encontrar Kisk à venda? (pode escolher uma ou mais opções)

- ☐ Merceria (7)
- ☐ Loja de produtos gourmet (1)
- ☐ Lojas de produtos étnicos (5)
- ☐ Supermercados - Secção gourmet (2)
- ☐ Supermercados - Secção de merceria (3)
- ☐ Supermercado - Secção de take-away/refeições preparadas (4)

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Report on near-market consumer testing of new improved products in Europe for Group 1

Q96 Indique em que medida cada uma destas frases se aplica a si:

	1- Discordo Totalmente (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (6)	7-Concordo Totalmente (7)
Gosto de continuar a fazer as mesmas coisas de sempre, em vez de experimentar coisas novas e diferentes (8)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Gosto de experimentar novidade e mudança no meu dia-à-dia (9)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Aprecio um emprego que me proporcione mudança, variedade e a possibilidade de viajar, mesmo que também envolva algum perigo (10)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Procuro constantemente ideias e experiências novas (11)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Gosto de mudar constantemente de atividade (12)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Quando as coisas se tornam rotineiras, gosto de experimentar algo de novo e diferente (13)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Prefiro um estilo de vida rotineiro a um imprevisível e cheio de mudanças (14)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

AFTER (G.A nº245025) – Deliverable 5.4.2.1

Report on near-market consumer testing of new improved products in Europe for Group 1

Q98 Indique em que medida cada uma destas frases se aplica ao seu padrão de consumo alimentar:

	1- Discordo Totalmente (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (7)	7-Concordo Totalmente (8)
Embora certos produtos alimentares estejam disponíveis no mercado em vários sabores, tenho tendência a comprar sempre o mesmo sabor (8)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Prefiro continuar a comprar os produtos alimentares que costumo usar, do que experimentar comprar outros que não conheço tão bem (9)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Considero-me um consumidor leal às marcas, no que toca a produtos alimentares (10)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Quando vejo um produto alimentar novo no supermercado, não tenho medo de o comprar para experimentar (11)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Quando vou comer a um restaurante, prefiro pedir pratos que já conheço para não arriscar (12)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Se gosto de um produto alimentar, raramente mudo só para experimentar uma coisa diferente (13)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q100 Muito obrigado pela sua participação!

Annex 2 Akpan consumer questionnaire

Nous vous remercions d'avoir accepté de participer à cette étude d'acceptabilité d'un nouveau type de « yaourt » en nous donnant votre point de vue.

Il vous sera demandé de tester trois types de « yaourt » l'un après l'autre, dans l'ORDRE et au MOMENT indiqués, et de remplir le questionnaire. Cela ne vous prendra qu'une dizaine de minutes.

Il est important que vous répondiez à TOUTES LES QUESTIONS de manière aussi précise et sincère que possible.

Merci!

Veillez cocher OU sélectionner votre réponse:

Sexe:

- ☐ Féminin
- ☐ Masculin

Année de naissance :

Nationalité

- ☐ Française
- ☐ Autre. Précisez:

Pays de Résidence

- ☐ France
- ☐ Autre. Précisez:

Niveau d'études

- ☐ ≤ Bac
- ☐ Bac+2
- ☐ Bac+3:
- ☐ Bac+5
- ☐ ≥ Bac+8

Consommez-vous des yaourts ?

- ☐ Oui, tous les jours
- ☐ Oui, une ou plusieurs fois par semaine
- ☐ Oui, une ou plusieurs fois par mois
- ☐ Rarement
- ☐ Jamais

Pourquoi consommez-vous des yaourts ?

(Cochez une ou plusieurs cases selon votre choix)

- | | |
|--------------------------------------|--|
| <input type="radio"/> Plaisir | <input type="radio"/> Nutritionnel |
| <input type="radio"/> Santé | <input type="radio"/> Prix convenable |
| <input type="radio"/> Energie | <input type="radio"/> Habitude |
| <input type="radio"/> Rafraichissant | <input type="radio"/> Facile à digérer |

AFTER (G.A n°245025) – Deliverable 5.4.2.1

Report on near-market consumer testing of new improved products in Europe for Group 1

Consommez-vous des laits végétaux comme le lait de soja ou le lait de riz ?

- ☐ Oui, tous les jours
- ☐ Oui, une ou plusieurs fois par semaine
- ☐ Oui, une ou plusieurs fois par mois
- ☐ Rarement
- ☐ Jamais

Pourquoi consommez-vous des laits végétaux comme le lait de soja ou le lait de riz ?

(Cochez une ou plusieurs cases selon votre choix)

- | | |
|-------------------------------------|--|
| <input type="radio"/> Plaisir | <input type="radio"/> Nutritionnel |
| <input type="radio"/> Santé | <input type="radio"/> Prix convenable |
| <input type="radio"/> Energie | <input type="radio"/> Habitude |
| <input type="radio"/> Rafrachissant | <input type="radio"/> Facile à digérer |

Veillez tester le produit 4P8.

Veillez nous donner votre APPRECIATION GLOBALE du produit 4P8.

- ☐ Extrêmement agréable
- ☐ Très agréable
- ☐ Agréable
- ☐ Un peu agréable
- ☐ Ni agréable, ni désagréable
- ☐ Un peu désagréable
- ☐ Désagréable
- ☐ Très désagréable
- ☐ Extrêmement désagréable

Comment percevez-vous LA TEXTURE du produit 4P8 ?

- | | | |
|---------------------------------------|---------------------------------------|---------------------------------------|
| <input type="checkbox"/> Trop liquide | <input type="checkbox"/> Comme j'aime | <input type="checkbox"/> Trop épaisse |
|---------------------------------------|---------------------------------------|---------------------------------------|

Comment percevez-vous LE GOÛT du produit 4P8 ?

- | | | |
|--------------------------------------|---------------------------------------|------------------------------------|
| <input type="checkbox"/> Trop faible | <input type="checkbox"/> Comme j'aime | <input type="checkbox"/> Trop fort |
|--------------------------------------|---------------------------------------|------------------------------------|

Comment percevez-vous L'ODEUR du produit 4P8 ?

- | | | |
|--------------------------------------|---------------------------------------|------------------------------------|
| <input type="checkbox"/> Trop faible | <input type="checkbox"/> Comme j'aime | <input type="checkbox"/> Trop fort |
|--------------------------------------|---------------------------------------|------------------------------------|

Comment percevez-vous LA SAVEUR SUCREE du produit 4P8 ?

- | | | |
|--------------------------------------|---------------------------------------|-------------------------------------|
| <input type="checkbox"/> Trop faible | <input type="checkbox"/> Comme j'aime | <input type="checkbox"/> Trop forte |
|--------------------------------------|---------------------------------------|-------------------------------------|

Comment percevez-vous L'ACIDITE du produit 4P8 ?

- | | | |
|--------------------------------------|---------------------------------------|-------------------------------------|
| <input type="checkbox"/> Trop faible | <input type="checkbox"/> Comme j'aime | <input type="checkbox"/> Trop forte |
|--------------------------------------|---------------------------------------|-------------------------------------|

AFTER (G.A n°245025) – Deliverable 5.4.2.1

Report on near-market consumer testing of new improved products in Europe for Group 1

Veillez cocher LES DESCRIPTEURS QUI DECRIVENT AU MIEUX le produit 4P8
(Cochez une ou plusieurs cases se/on votre choix)

- | | | | |
|--|--|--|--|
| <input type="checkbox"/> Grumeaux | <input type="checkbox"/> Neutre/Nature | <input type="checkbox"/> Rafrachissant | <input type="checkbox"/> Nouveau/différent |
| <input type="checkbox"/> Fade/insipide | <input type="checkbox"/> Acide | <input type="checkbox"/> Naturel | <input type="checkbox"/> Epais |
| <input type="checkbox"/> Aigre | <input type="checkbox"/> Bon pour la santé | <input type="checkbox"/> Fermenté | <input type="checkbox"/> Homogène |
| <input type="checkbox"/> Liquide | <input type="checkbox"/> Sucré | <input type="checkbox"/> Goût Lait | <input type="checkbox"/> Floral |
| <input type="checkbox"/> Gélatineux | <input type="checkbox"/> Yaourt bulgare | <input type="checkbox"/> Farineux | <input type="checkbox"/> Céréales |
| <input type="checkbox"/> Onctueux | <input type="checkbox"/> Artificiel | <input type="checkbox"/> Nutritif | <input type="checkbox"/> Apre/Râpeux |
| <input type="checkbox"/> Attirant | <input type="checkbox"/> Yaourt à boire | <input type="checkbox"/> Soja | <input type="checkbox"/> Aqueux |

Veillez cocher LA PROBABILITE DE CONSOMMER le produit 4P8 s'il était disponible sur le marché.

- ☐ Certainement
- ☐ Presque sûrement
- ☐ Très probablement
- ☐ Probablement
- ☐ Bonne possibilité
- ☐ Assez bonne possibilité
- ☐ Possibilité moyenne
- ☐ Quelques possibilités
- ☐ Faible possibilité
- ☐ Très faible possibilité
- ☐ Aucune chance

Veillez tester le produit 6Z3.

Veillez nous donner votre APPRECIATION GLOBALE du produit 6Z3

- ☐ Extrêmement agréable
- ☐ Très agréable
- ☐ Agréable
- ☐ Un peu agréable
- ☐ Ni agréable, ni désagréable
- ☐ Un peu désagréable
- ☐ Désagréable
- ☐ Très désagréable
- ☐ Extrêmement désagréable

Comment percevez-vous LA TEXTURE du produit 6Z3 ?

- | | | |
|---------------------------------------|---------------------------------------|---------------------------------------|
| <input type="checkbox"/> Trop liquide | <input type="checkbox"/> Comme j'aime | <input type="checkbox"/> Trop épaisse |
|---------------------------------------|---------------------------------------|---------------------------------------|

Comment percevez-vous LE GOÛT du produit 6Z3 ?

- | | | |
|--------------------------------------|---------------------------------------|------------------------------------|
| <input type="checkbox"/> Trop faible | <input type="checkbox"/> Comme j'aime | <input type="checkbox"/> Trop fort |
|--------------------------------------|---------------------------------------|------------------------------------|

AFTER (G.A n°245025) – Deliverable 5.4.2.1

Report on near-market consumer testing of new improved products in Europe for Group 1

Comment percevez-vous L'ODEUR du produit 6Z3 ?

☐ Trop faible

☐ Comme j'aime

☐ Trop fort

Comment percevez-vous LA SAVEUR SUCREE du produit 6Z3 ?

☐ Trop faible

☐ Comme j'aime

☐ Trop forte

Comment percevez-vous L'ACIDITE du produit 6Z3 ?

☐ Trop faible

☐ Comme j'aime

☐ Trop forte

Veillez cocher LES DESCRIPTEURS QUI DECRIVENT AU MIEUX le produit 6Z3

(Cochez une ou plusieurs cases se/on votre choix)

☐ Grumeaux

☐ Neutre/Nature

☐ Rafrichissant

☐ Nouveau/différent

☐ Fade/insipide

☐ Acide

☐ Naturel

☐ Epais

☐ Aigre

☐ Bon pour la santé

☐ Fermenté

☐ Homogène

☐ Liquide

☐ Sucré

☐ Goût Lait

☐ Floral

☐ Gélatineux

☐ Yaourt bulgare

☐ Farineux

☐ Céréales

☐ Onctueux

☐ Artificiel

☐ Nutritif

☐ Apre/Râpeux

☐ Attirant

☐ Yaourt à boire

☐ Soja

☐ Aqueux

Veillez cocher LA PROBABILITE DE CONSOMMER le produit 6Z3 s'il était disponible sur le marché.

- ☐ Certainement
- ☐ Presque sûrement
- ☐ Très probablement
- ☐ Probablement
- ☐ Bonne possibilité
- ☐ Assez bonne possibilité
- ☐ Possibilité moyenne
- ☐ Quelques possibilités
- ☐ Faible possibilité
- ☐ Très faible possibilité
- ☐ Aucune chance

Veuillez tester le produit E7Q

Veuillez nous donner votre APPRECIATION GLOBALE du produit E7Q

- ☐ Extrêmement agréable
- ☐ Très agréable
- ☐ Agréable
- ☐ Un peu agréable
- ☐ Ni agréable, ni désagréable
- ☐ Un peu désagréable
- ☐ Désagréable
- ☐ Très désagréable
- ☐ Extrêmement désagréable

Comment percevez-vous LA TEXTURE du produit E7Q ?

- ☐ Trop liquide ☐ Comme j'aime ☐ Trop épaisse

Comment percevez-vous L'ODEUR du produit E7Q ?

- ☐ Trop faible ☐ Comme j'aime ☐ Trop fort

Comment percevez-vous LE GOÛT du produit E7Q ?

- ☐ Trop faible ☐ Comme j'aime ☐ Trop fort

Comment percevez-vous LA SAVEUR SUCREE du produit E7Q ?

- ☐ Trop faible ☐ Comme j'aime ☐ Trop forte

Comment percevez-vous L'ACIDITE du produit E7Q ?

- ☐ Trop faible ☐ Comme j'aime ☐ Trop forte

Veuillez cocher LES DESCRIPTEURS QUI DECRIVENT AU MIEUX le produit E7Q

(Cochez une ou plusieurs cases se/on votre choix)

- | | | | |
|--|--|---|--|
| <input type="checkbox"/> Grumeaux | <input type="checkbox"/> Neutre/Nature | <input type="checkbox"/> Rafraichissant | <input type="checkbox"/> Nouveau/différent |
| <input type="checkbox"/> Fade/insipide | <input type="checkbox"/> Acide | <input type="checkbox"/> Naturel | <input type="checkbox"/> Epais |
| <input type="checkbox"/> Aigre | <input type="checkbox"/> Bon pour la santé | <input type="checkbox"/> Fermenté | <input type="checkbox"/> Homogène |
| <input type="checkbox"/> Liquide | <input type="checkbox"/> Sucré | <input type="checkbox"/> Goût Lait | <input type="checkbox"/> Floral |
| <input type="checkbox"/> Gélatineux | <input type="checkbox"/> Yaourt bulgare | <input type="checkbox"/> Farineux | <input type="checkbox"/> Céréales |
| <input type="checkbox"/> Onctueux | <input type="checkbox"/> Artificiel | <input type="checkbox"/> Nutritif | <input type="checkbox"/> Apre/Râpeux |
| <input type="checkbox"/> Attirant | <input type="checkbox"/> Yaourt à boire | <input type="checkbox"/> Soja | <input type="checkbox"/> Aqueux |

AFTER (G.A n°245025) – Deliverable 5.4.2.1

Report on near-market consumer testing of new improved products in Europe for Group 1

Veillez cocher LA PROBABILITE DE CONSOMMER le produit E7Q s'il était disponible sur le marché.

- ☐ Certainement
- ☐ Presque sûrement
- ☐ Très probablement
- ☐ Probablement
- ☐ Bonne possibilité
- ☐ Assez bonne possibilité
- ☐ Possibilité moyenne
- ☐ Quelques possibilités
- ☐ Faible possibilité
- ☐ Très faible possibilité
- ☐ Aucune chance

Pouvez-vous maintenant décrire le yaourt idéal pour vous

Pouvez-vous maintenant décrire LE YAOURT IDEAL pour vous

- | | | | |
|--|--|---|--|
| <input type="checkbox"/> Grumeaux | <input type="checkbox"/> Neutre/Nature | <input type="checkbox"/> Rafraichissant | <input type="checkbox"/> Nouveau/différent |
| <input type="checkbox"/> Fade/insipide | <input type="checkbox"/> Acide | <input type="checkbox"/> Naturel | <input type="checkbox"/> Epais |
| <input type="checkbox"/> Aigre | <input type="checkbox"/> Bon pour la santé | <input type="checkbox"/> Fermenté | <input type="checkbox"/> Homogène |
| <input type="checkbox"/> Liquide | <input type="checkbox"/> Sucré | <input type="checkbox"/> Goût Lait | <input type="checkbox"/> Floral |
| <input type="checkbox"/> Gélatineux | <input type="checkbox"/> Yaourt bulgare | <input type="checkbox"/> Farineux | <input type="checkbox"/> Céréales |
| <input type="checkbox"/> Onctueux | <input type="checkbox"/> Artificiel | <input type="checkbox"/> Nutritif | <input type="checkbox"/> Apre/Râpeux |
| <input type="checkbox"/> Attirant | <input type="checkbox"/> Yaourt à boire | <input type="checkbox"/> Soja | <input type="checkbox"/> Aqueux |

AFTER (G.A n°245025) – Deliverable 5.4.2.1

Report on near-market consumer testing of new improved products in Europe for Group 1

Vous allez voir ci-dessous différents types d'emballage de produits type « yaourts »

Veillez classer par ordre décroissant de préférence l'emballage que vous souhaiteriez pour ce type de « yaourt ».

Pour cela, faire glisser les photos d'emballage A, B, C, D, E, F de haut en bas

En Haut (position1) : pour l'emballage le plus approprié pour ce type de « yaourt »

En Bas (position 6) : pour l'emballage le moins approprié pour ce type de « yaourt ».

